Medi-Cal Managed Care Division's Third Annual Quality Improvement Conference

Quality 2000: Meeting the Challenge

Sacramento Convention Center
February 28, 2000
9AM – 4PM

General Session Presentations

Rooms 307/308

8:00 AM	Registration and Continental Breakfast	
9:00 AM – 9:30 AM	Welcome and Overview	Mary Fermazin, MD, MPA, *Chief, Office of Clinical Standards and Quality* *California Department of Health Services*
	Opening Remarks	Susanne M. Hughes *Acting Division Chief of Medi-Cal Managed Care* *California Department of Health Services*
	Conference Moderator	Mary Ellen Dalton, MBA, RN, CHCA *Vice President, State and Corporate Services* *Health Services Advisory Group, Inc.*
9:30 AM – 10:15 AM	Quality 2000: The Federal Challenge	Ann Page, RN, MPH *Technical Director of QI Systems* *Health Care Financing Administration*
10:15 AM – 10:30 AM	Break	
10:30 AM – 11:30 AM	Evidence Based Medicine: What Are the Practical Implications?	David M. Eddy, MD, PhD *Senior Advisor, Health Policy and Management* *Kaiser Permanente, Southern California*
11:30 AM – 12:15 PM	Challenges and Opportunities for Quality Improvement in Medicaid Managed Care	Elaine E. Batchlor, MD, MPH *Vice President* *California HealthCare Foundation*

Luncheon Presentation

Room 314/315

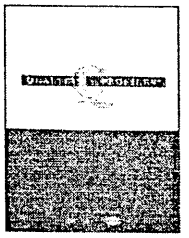
12:15 PM– 1:30 PM	Luncheon Proven Strategies To Improve Vaccination Coverage	Lance E. Rodewald, MD *Associate Director for Science, Immunization Services Division Centers for Disease Control and Prevention*

Afternoon Workshops

1:30 PM – 2:30 PM	*Concurrent Workshop* Room 307/308 1. Managed Care Quality Profiles	Margaret Beed, MD *Vice President* *horses, zebras & unicorns, inc.*
	Concurrent Workshop Room 306 2. The 1999 HEDIS Experience – Challenges and Best Practices	HSAG HEDIS Certified Auditors: Peggy Ketterer, RN David Mabb, MS Health Plan Representatives: Karen Bowman, PhD *Inland Empire Health Plan* Carlos Hernandez *Santa Barbara Regional Health Authority*
2:30 PM – 2:45 PM	Break	
2:45 PM – 3:45 PM	*Concurrent Workshop* Room 307/308 1. Managed Care Quality Profiles	Margaret Beed, MD *Vice President* *horses, zebras & unicorns, inc.*
	Concurrent Workshop Room 306 2. The 1999 HEDIS Experience – Challenges and Best Practices	HSAG HEDIS Certified Auditors: Peggy Ketterer, RN David Mabb, MS Health Plan Representatives: Karen Bowman, PhD *Inland Empire Health Plan* Carlos Hernandez *Santa Barbara Regional Health Authority*
3:45 PM - 4:00 PM	Closing and Evaluation	(Conference Moderators)

Outline

- Overview of Quality Profiles™
- Case study examples
- Lessons learned
- Key themes

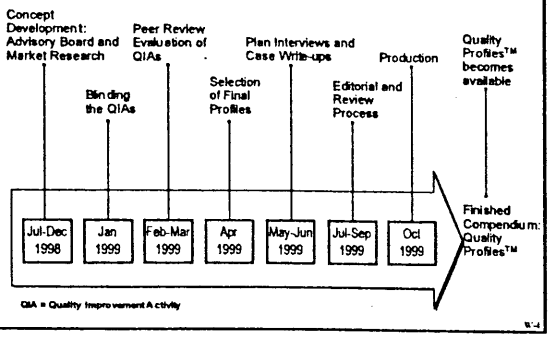


Quality Profiles™ is a trademark of the National Committee for Quality Assurance (NCQA). Quality Profiles is a program funded by Pfizer Inc.

Disclaimers

- Cases presented are taken directly from Quality Profiles™
- Public health statistics included are taken directly from the profiles
  - Represents statistics that health plans submitted to NCQA
  - May be outdated

The Development of Quality Profiles™



The Development of Quality Profiles™

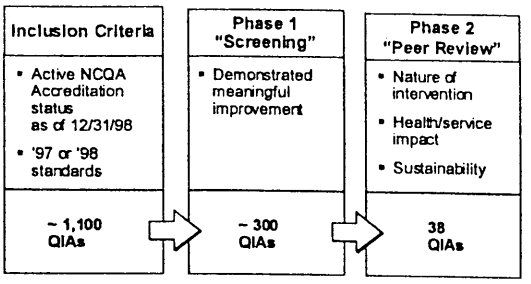
- Advisory board
- Qualitative market research
- Three criteria emerged:
  - Meaningful quality impact on health or service
  - Sustainable
  - Could be replicated

Market Research

Exploring and Testing an Idea

Market Research	Key Finding
▪ 38 medical and quality directors in Spring 1998 ▪ 50 medical and quality directors in Fall 1998	▪ 68% said a compendium would help improve care ▪ 96% said a compendium would be a useful reference

Quality Profiles™ Methodology



Case Study Categories

38 Case Studies Organized into Five Sections

1. **Chronic Illness**
2. **Women's Health**
3. **Preventive Care**
4. **Behavioral Health**
5. **Service**

The Components of Each Profile

- Selecting the activity
- Setting the parameters
- Implementing the initiative
- Epilogue
- Attachments (when available, included in appendix)

Chronic Illness

Key Themes

- Living with illness is an important aspect of health care
- Successful programs empower patients to participate in collaborating with their provider

Examples in Quality Profiles™

- Asthma
- Diabetes
- HIV+/AIDS
- Lipid management

W-10

Asthma: Selecting the Activity

- One of top reasons for inpatient admission
  - Most common in pediatrics
- One of top reasons for outpatient visits, including ER
- Public health statistics:
  - 15 million Americans
  - $6.2 billion in costs related to asthma (profile #2)
  - 5,000 deaths a year

Reference: Quality Profiles™. In Pursuit of Excellence in Managed Care. NCQA: 1999. Profiles 1-4, p. 3-26. Data provided by health plans.

W-11

Asthma: Setting the Parameters

Performance measures

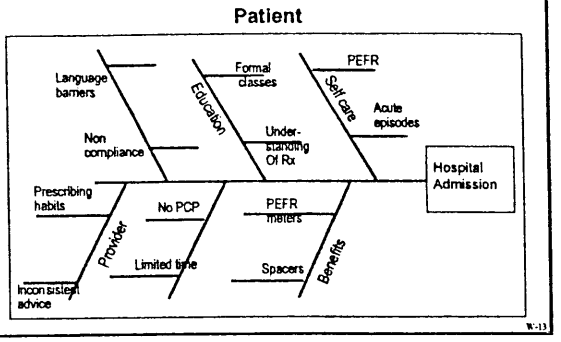
- Hospital admissions and readmissions
- ER/UV visits
- Use of anti-inflammatory medications
- Use of specialists
- Use of Peak Expiratory Flow Rates (PEFR)
- Days missed from work/school

Targeting the population

- Encounter and pharmacy data
- Severity classifications

W-12

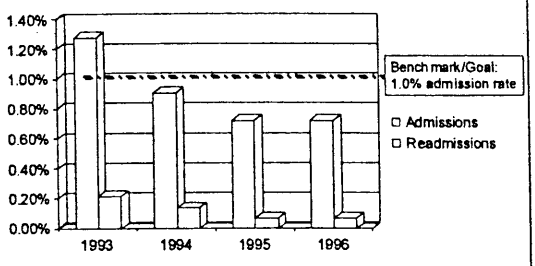
Asthma: Barrier Analysis



Asthma Interventions

- Education:
  - Providers Guidelines
  - Telephone protocols
  - Patients
  - Incentives
- Benefit changes
- Case management
- Patient profiles

Pediatric Asthma Admissions



Diabetes: Selecting the Activity

- One of top reasons for inpatient admission
- 5% of a plan's patients with diabetes consumed 13% of medical care resources (profile #11)
- Opportunity to improve clinical outcomes
  - DCCT, UKPDS
    - Glucose control

Reference: Quality Profiles™, NCQA; 1999. Profiles 5-11, p. 27-64. Data provided by health plans.

W-16

Diabetes: Setting the Parameters

Performance measures

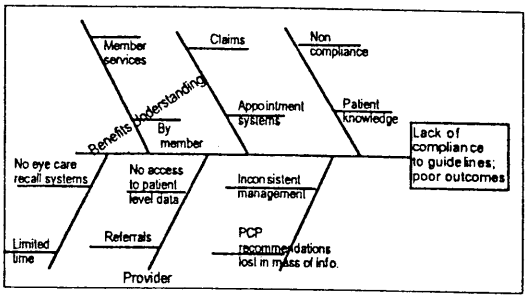
- Retinal exams
- Annual foot exams
- Annual tests for proteinuria
- Annual HbA_{1C}
- Annual lipid testing
- Percent achieving $HbA_{1C} < 8$
- Population mean HbA_{1C}

Targeting the population

- Encounter and pharmacy data

W-17

Diabetes: Barrier Analysis



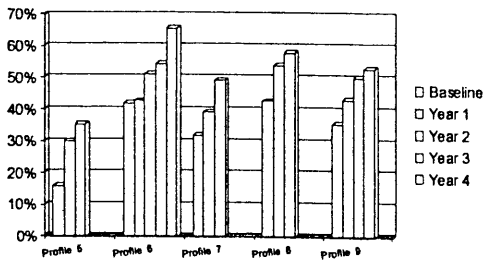
W-18

Diabetes Interventions

- Education:
  - Providers
    - Guidelines
  - Patients
    - Education on benefits
- Case management / care teams
- Diabetic registry
- Patient profiles
- Tracking and reminder systems

W-19

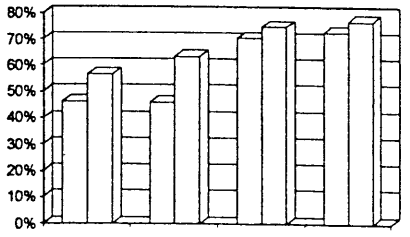
Annual Diabetic Retinal Exams



Reference: Quality Profiles™, NCQA, 1999. Profile 9, p. 30-51. Data provided by health plans.

W-20

Annual Diabetic Exams



Reference: Quality Profiles™, NCQA, 1999. Profile 9, p. 52. Data provided by health plans.

W-21

Women's Health

Key Themes

- Women have unique healthcare needs
- Women are major consumers and decision makers in health care
- Other profiles also address important women's health issues, such as cardiovascular disease

Examples in Quality Profiles™

- Breast Cancer Screening
- Cervical Cancer Screening
- Caesarian sections & VBAC
- Prenatal care
- Laparoscopic cholecystectomies

W-22

Preventive Care

Key Themes

- Prevention as the core of managed care
- Economic value of prevention v. treatment
- Effective preventive care requires a system

Examples in Quality Profiles™

- Childhood immunizations
- Influenza immunizations for seniors

W-23

Behavioral Health

Key Themes

- High correlation between behavioral health and low worker productivity
- The challenge of the traditional separation between general medical care and behavioral health

Examples in Quality Profiles™

- Major affective disorder

W-24

Service

Key Themes

- The importance of member satisfaction to a health plan's success
- Need to understand needs of members
- Implement a broad range of specific interventions

Examples in Quality Profiles™

- Referral process
- Pharmacy wait times
- Member satisfaction
- Resolution time for member grievances
- Primary care appointment access
- Access to behavioral health

Member Satisfaction: Selecting the Activity

- One third of complaints from major provider group that cared for 11.5% of patients
- Widespread dissatisfaction with:
  - Referrals
  - Wait times
  - Provider communication

Reference: Quality Profiles™. NCQA; 1999. Profiles 33-38, p. 179-210. Data provided by health plans.

W-26

Member Satisfaction: Setting the Parameters

Performance measures

- Percentage of complaints originating with targeted medical group
- Percentage of members reporting they were satisfied overall after visiting targeted medical group

Targeting the population

- All plan members who received care from targeted medical group

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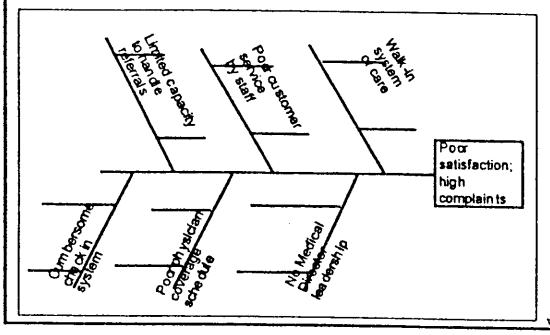
Member Satisfaction: Barrier Analysis



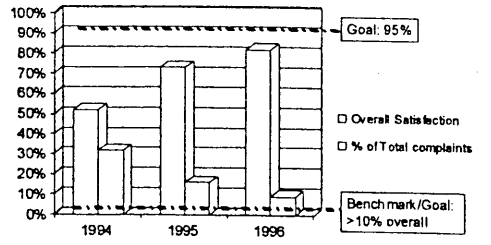
Member Satisfaction Interventions

- Referral process
  - Temporary subcontract with IPA
  - Education and workflow improvements to allow group to re-assume referral processing
- Customer service training
- Automated check-in system
- Appointment system

Member Satisfaction Interventions (cont'd)

- Restructuring physician schedules
- Creating physician/nurse care teams
- Assigning accountability to specific staff
- Installing separate prescription phone line
- Assisted in recruiting a medical director

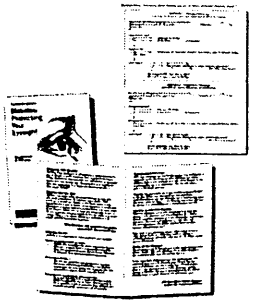
Member Satisfaction



Reference: Quality Profiles™, NCQA: 1999 Profile 33, p. 102. Data provided by health plans.

W-31

Appendices



- Newsletters
  - Member
  - Provider
- Tracking sheets
- Practice guidelines
- Refill guides
- Fliers

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Getting the Most of Quality Profiles™

QI, Medical and Pharmacy Professionals

Information Services Professionals

Senior Management

Member Services, Claims

W-33

How Quality Profiles™ Can Help You

With Quality Profiles™ you can:

- Adapt these successful initiatives to help meet your organization's specific needs
- Gain a clearer understanding of the time, resources, and staffing required to execute a successful QI initiative
- Use the examples to help demonstrate that the managed care industry is dedicated to achieving excellence in delivery of healthcare

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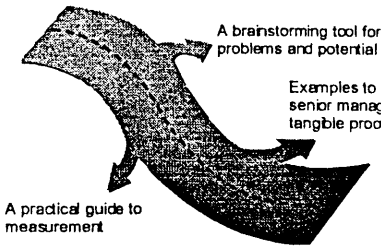
Quality Profiles™ : Your Roadmap to Effective QI Planning



- A brainstorming tool for identifying problems and potential solutions
- Examples to gain buy-in from senior management with tangible proof that QI works
- A practical guide to measurement

W-35

Lessons Learned

Target your interventions

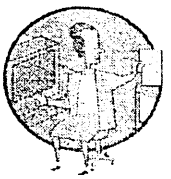
- Resources are limited
- Target your interventions
- Foundational efforts
- KISS ("Keep it simple, stupid") principle
- Use of HEDIS®
- Is there a "Clinical Champion"?

W-36

Lessons Learned

Automation

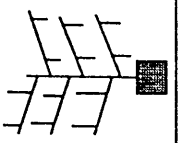
- Registries / Tracking systems
- Reminder systems / chart flags
- Flow charts
- Check sheets



Lessons Learned

Barrier Analysis

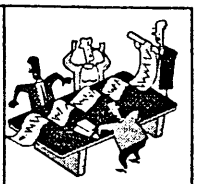
- Pre-implementation
- Fishbone diagrams
- Periodic review
- Brainstorming
- Data driven
- Administrative as well as clinical barriers



Lessons Learned

Multidisciplinary Involvement

- On QI Teams
- To give input into:
  - Guidelines
  - Work process changes
- To drive initiative
- Curbside consults
- Peer pressure



Key Themes

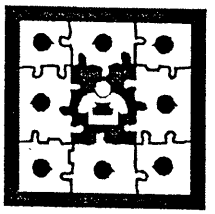
- Leadership
  - Senior management
  - Clinicians
- Teamwork
- Listening to the "voice of the customer"
  - Surveys
  - Focus groups
- Partnering with vendors

The bottom line: There is excellence

W-40

Key Steps to Success

- Variation in approaches
- Focus and prioritizing
- Use of HEDIS®
- Data challenges
- Benchmarking
- Innovation v. duplication
- Effective implementation
- Mid-course corrections



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Summary

- Quality Profiles™ is one of the first compendium of its kind
- Examples of real life quality improvement exist in a number of areas
- You and your organization can use Quality Profiles™ in a number of ways
- There are key themes that run throughout the case studies
- Managed care can be better care

W-42

References

NCQA. Accreditation '99: Surveyor Guidelines for the Accreditation of Managed Care Organizations. Effective July 1, 1999 – June 30, 2000. NCQA; 1998.

Quality Profiles™: In Pursuit of Excellence in Managed Care. NCQA; 1999.

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HEALTH SERVICES ADVISORY GROUP

THE 1999 HEDIS® EXPERIENCE – CHALLENGES AND BEST PRACTICES

BREAK-OUT SESSION AGENDA

1. Introductions of Health Plan Representatives and HSAG Staff	Peggy Ketterer, RN, BSN Project Manager *Health Services Advisory Group*
2. Discussion Item: The Use of PM-160 Data in HEDIS Reporting	Karen Bowman, PhD Research and Analysis Manager *Inland Empire Health Plan*
3. Discussion Item: Live Birth Identification Strategies	Carlos Hernandez, Senior QI Analyst *Santa Barbara Regional Health Authority*
4. Discussion Item: One Method for Determining the Eligible Population for the Well-Child Visits in the First 15 Months of Life Measure	David Mabb, MS Senior Statistician *Health Services Advisory Group*
5. Questions and Answers	Audience and Presenters

Inland Empire Health Plan
PM160 Data Entry Form

Edit Member | Search by Name | Search by SSN | Search by DOB / Name

PM160 ID: 118281 Batch ID: 12929 Receive Date: Newborn?

(SUB ID)	Social Security Number	PATIENT NAME (LAST)	(FIRST)	(MI)	PCP ID	ETHNIC	ETHN_D
19990700428001		CROWELL	MEGANN		T161750	6	1

DATE OF BIRTH	AGE	CNTY	SEX	MEDCIAL NO.	PLAN CODE	TELEPHONE NUMBER	DATE OF SERVICE	NEXT VISIT
19990318	0 yr 11 mo	33	F		305	(909)	07/20/1999	09/20/1999

RESPONSIBLE PERSON (First + Las | Different Address | STREET | (APT/SPACE #) | CITY AND STATE | ZIP CODE

CANYON LA CA 9258789

Check Responsible Person Info

CHDP ASSESSMENT
Indicated outcome for each screening procedure

	NO PROBLEM EXPECTED A	Refused Contra Indicated Not Included B	Problem Suspected Enter Follow up Code In Appropiate Column NEW C	KNOWN D
01 HISTORY and PHYSICAL EXAM	☑	☐		
02 DENTAL ASSESSMENT / REFERRA	☑	☐		
03 NUTRITIONAL ASSESSMENT	☑	☐		
04 ANTICIPATORY GUIDANCE / HEALTH ED	☑	☐		
05 DEVELOPMENTAL ASSESSMENT	☑	☐		
06 SNELLEN OR EQUIVALENT	☑	☐		
07 AUDIOMETRIC	☑	☐		
08 HEMOGLOBIN OR HEMATOCRIT	☐	☑		
09 URINE DIPSTICK	☐	☑		
10 COMPLETE URINALYSIS	☐	☑		
11 TB MULTIPUNCTURE				
12 TB MANTOUX	☐	☑		

CODE OTHER TESTS — SEE CODES ON REVERSE SIDE OF LAST PAGE

	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	

H.C.	HEIGHT IN INCHES	WEIGHT IN LBS	BLOOD PRESS
	24 0/4	015lbs 09 oz	
HEMOGLOBIN		HEMATOCRIT	BIRTH WEIGHT

IMMUNIZATIONS

	Given Today: NOW UP TO DATE FOR AGE A	Given Today: STILLNOT UP TO DATE FOR AGE B	NOT Given Today: ALREADY UP TO DATE FOR AGE C	NOT Given Today: Refused or Contra Indicated D
31 Polio	☐	☐	☐	☑
32 DPT Dt/Td	☐	☐	☐	☑
33 MMR	☐	☐	☐	☑
38 Hib CV 2	☑	☐	☐	☐
39 Polio (IPV) 2	☑	☐	☐	☐
40 Hepb(VFC)L 2	☑	☐	☐	☐
45 DTaP 2	☑	☐	☐	☐
	☐	☐	☐	☐

Patient Visit: ☐ New Patient or Extended Visit ☑ Routine Visit ☐ N/A

Type of Screen: ☐ Initial ☑ Periodic ☐ N/A

PCP on Date Of Service: T161750 BAKR, SABRY E

Provider of Service ID if other than above:

Provider of Service if other than above:

Comments/Problems:

PROVIDER INFORMATION

PROVIDER TELEPHONE NO: (909) 698-5446 | PREPAID PROJECT CODE:

PROVIDER NAME: BAKR S

PROVIDER ADDRESS

PROVIDER ADDRESS: 36243 INLAND VALLEY DR #290

ROUTINE REFERRALS: ☐ BLOOD LEAD ☐ DENTAL | PATIENT IS A FOSTER CHIL ☐

ICD 9 CODES

1	2	3

THE QUESTIONS BELOW MUST BE ANSWERED

- ☐ Patient is Exposed to Passive (Second Hand) Tobacco Smoke
- ☐ Tobacco is Used by Patient
- ☑ Counseled About / Referred For Tobacco Use Prevention / Cessation

☐ ENROLLED IN WIC ☐ REFERRED TO WIC

☐ Partial Screen ☐ Screening Procedure Recheck

Accompanies Prior PM 160 Dated:

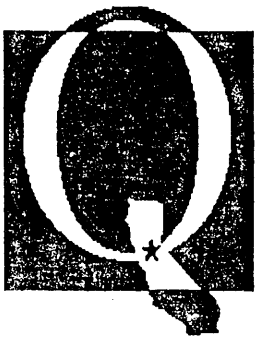
More INFO requested ☐ More INFO received ☐

Check if Wrong Form used. ☐

Date Entered: 08/11/1999

Date Edited: 02/24/2000 4:47:24 PM

Slide Notes For



Overview for Determining the Eligible Population for Well Child Visits in the First 15 Months of Life

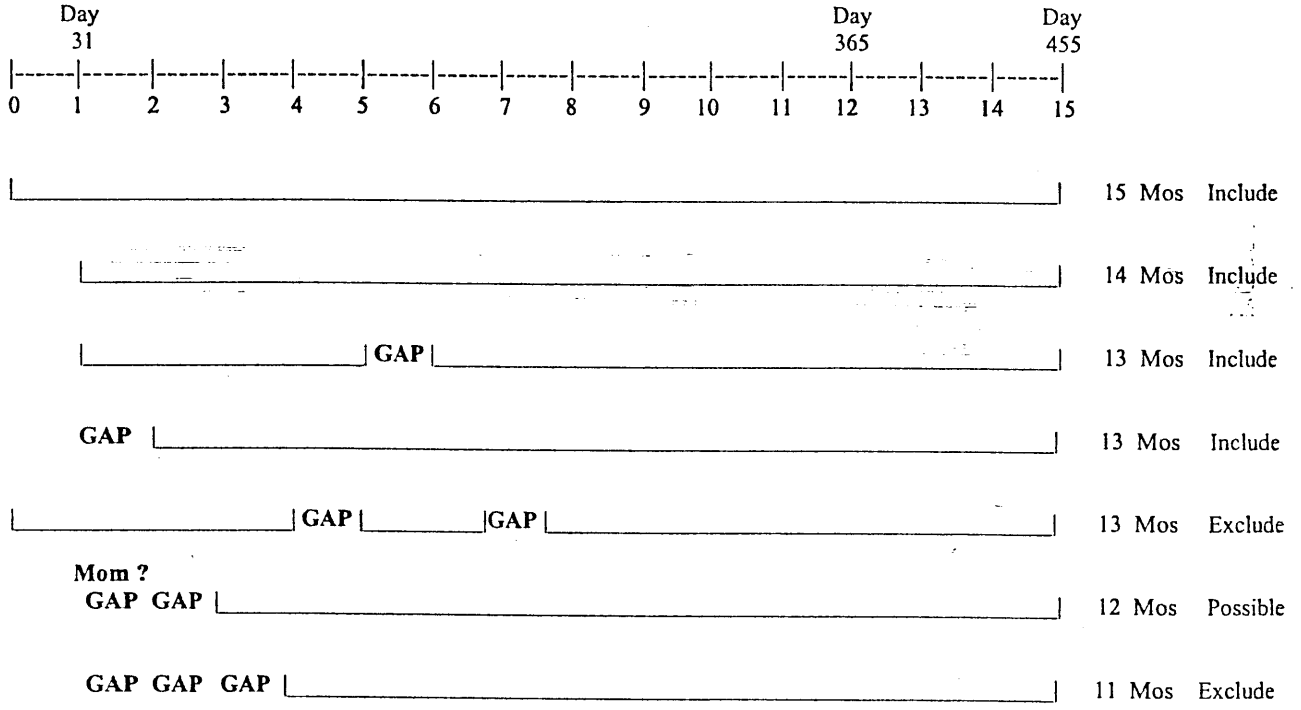
David Mabb, MS
Certified HEDIS® Compliance Auditor
Health Services Advisory Group

Well Child Visits in the First 15 Months of Life

Continuous Enrollment Criteria:

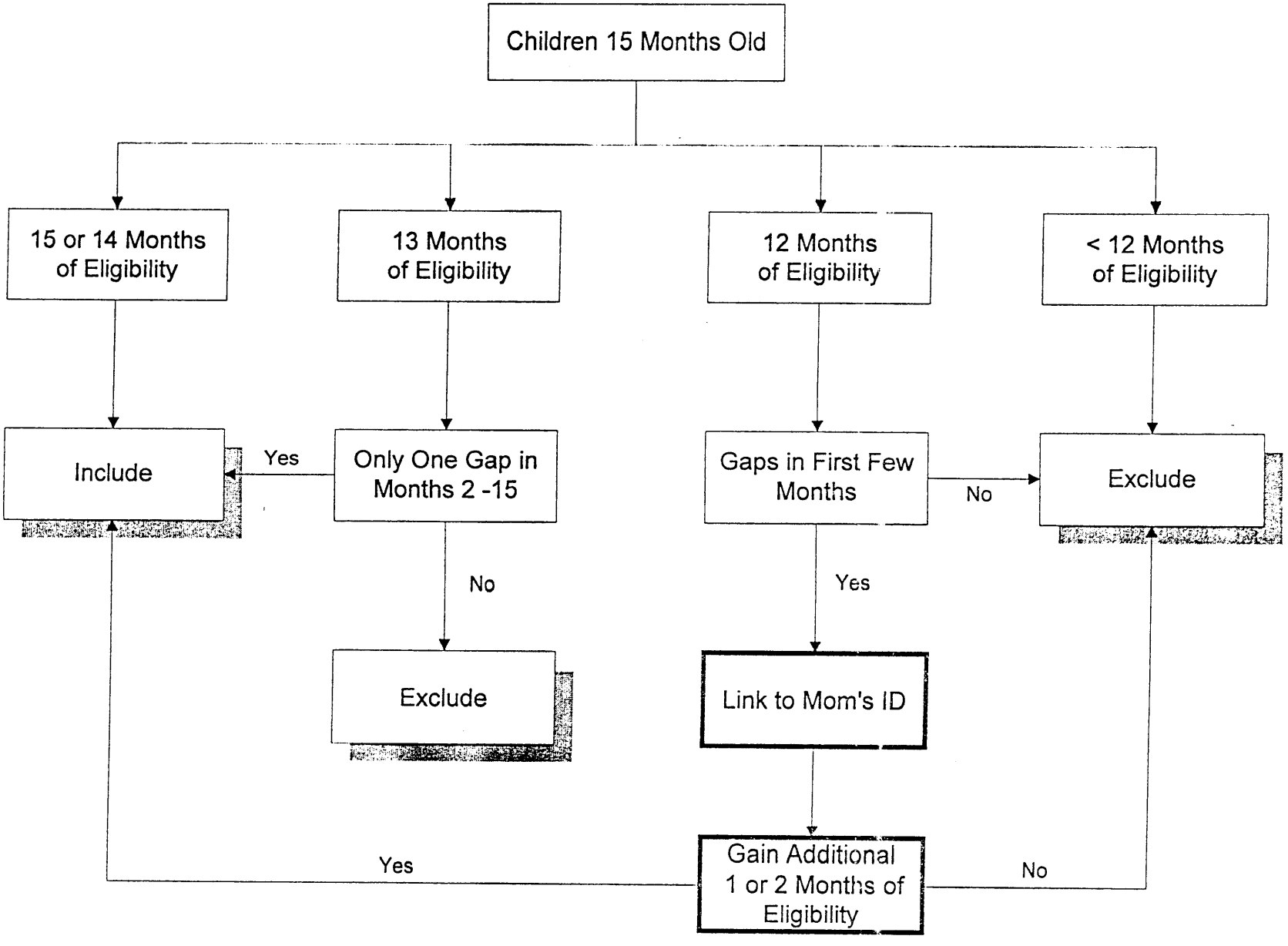
- Enrolled 31 days of age through 15 months.
- Define 15-month birthday as the child's first birthday plus 90 days.
  Child should have been born between October 3, 1997 and October 2, 1998.
- Enrolled as of the day the child turns 15 months of age.
- No more than one gap in enrollment up to 45 days during the continuous enrollment period. To determine continuous enrollment for a Medicaid member for whom enrollment is verified monthly, the member may not have more than a one month gap in coverage (i.e., a member whose coverage lapses for two months, or 60 days, is not considered continuously enrolled).

Potential Enrollment Scenarios



Members with 15 or 14 months of enrollment will qualify.
Members with 13 or 12 months of enrollment **may** qualify.
Members with less than 12 months of enrollment will not qualify.

One Possible Method to Determine the Eligible Population for Well Child Visits in the First 15 Months of Life



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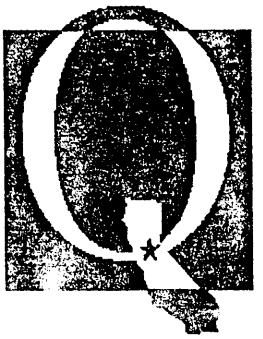


Using PM160 Data for HEDIS®

Karen Bowman, PhD
Research & Analysis Manager
Inland Empire Health Plan

Using PM160 Data for HEDIS®

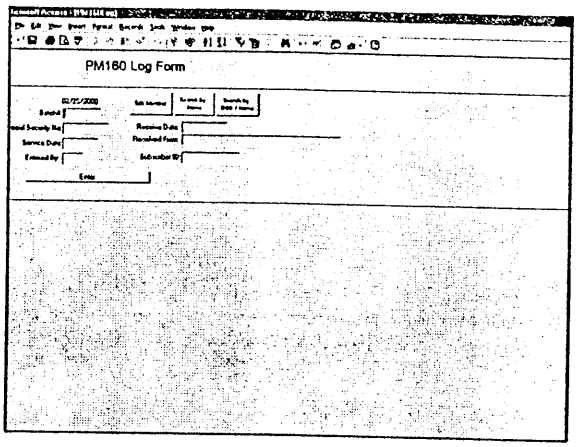
Karen Bowman
Research & Analysis Manager
Inland Empire Health Plan

PM160 Receipt Process

- PM160 completed
  - Patients between 0 and 20.9 years old
- IEHP Receives PM160
  - PM160s are received in batches and assigned a Batch ID by IEHP
  - Form is date stamped
  - Form is then input by Eligibility Technician

Log/Validation Process

- PM160 Logged in database
- Form checked for:
  - Valid Member ID (IEHP ID or SSN)
  - Valid Date of Service
  - Checking for Duplication



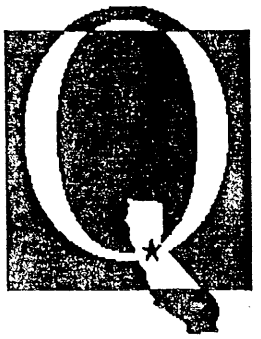
Input Process

- Data from form is entered as it appears on original PM160
- Newborns
  - Entered under Mother's ID
  - Mother's Delivery Date updated in Diamond
- Member's Phone Number updated in Diamond

Quality Assurance Audit Process

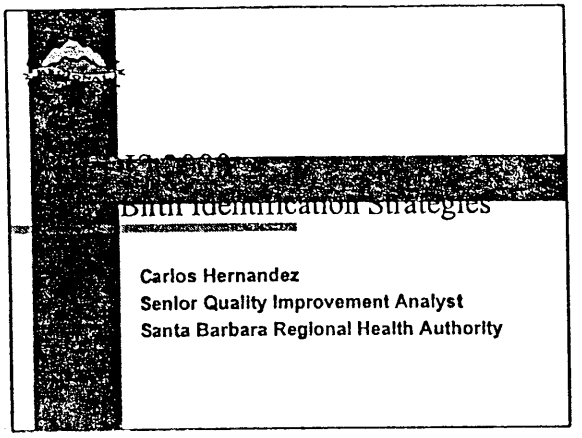
- Quality Assurance Technician randomly selects 20% of all forms
  - 100% audit on new Technicians
  - Original form checked against database
- If errors are found
  - Screen print is filed in QA log
  - Database is updated
  - Errors are reviewed with Technicians
  - Technicians re-trained if necessary

Slide Notes For



HEDIS 2000:
Live Birth Identification Strategies

Carlos Hernandez
Senior Quality Improvement Analyst
Santa Barbara Regional Health Authority


Birth Identification Strategies
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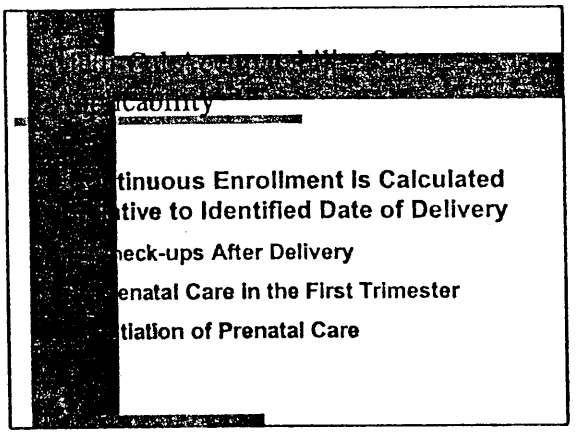
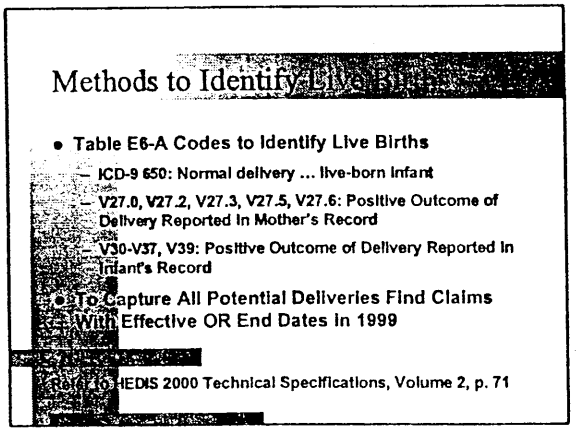
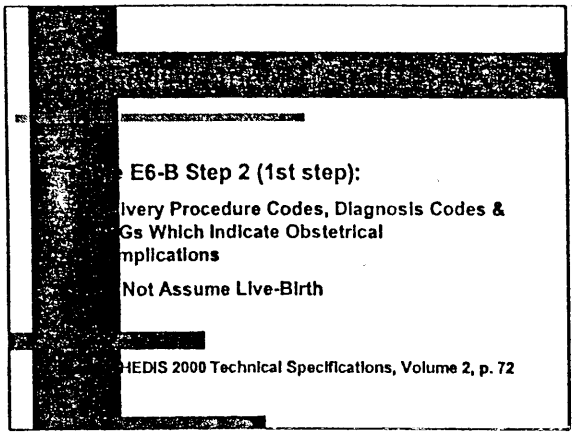
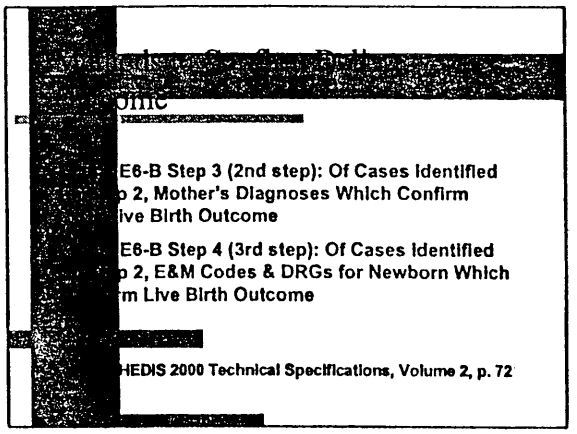
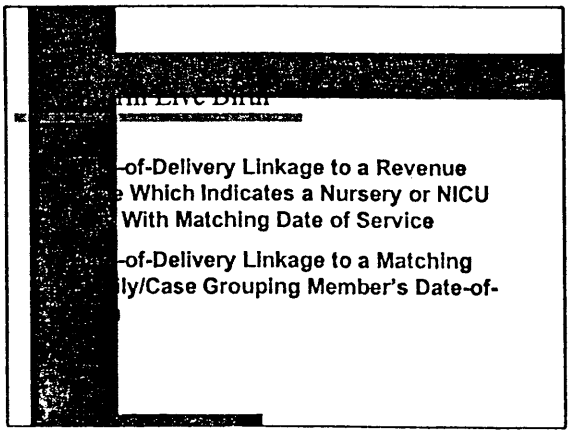
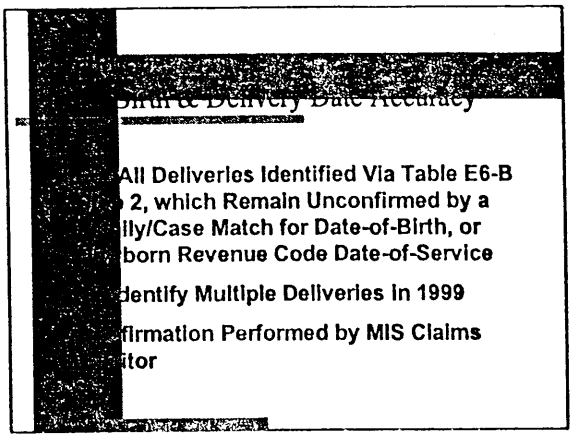

tinuous Enrollment Is Calculated
tive to Identified Date of Delivery
eck-ups After Delivery
enatal Care In the First Trimester
tiation of Prenatal Care


Methods to Identify Live Births
• Table E6-A Codes to Identify Live Births
– ICD-9 650: Normal delivery ... live-born infant
– V27.0, V27.2, V27.3, V27.5, V27.6: Positive Outcome of Delivery Reported In Mother's Record
– V30-V37, V39: Positive Outcome of Delivery Reported In Infant's Record
• To Capture All Potential Deliveries Find Claims With Effective OR End Dates In 1999
HEDIS 2000 Technical Specifications, Volume 2, p. 71


E6-B Step 2 (1st step):
ivery Procedure Codes, Diagnosis Codes &
Gs Which Indicate Obstetrical
mplications
Not Assume Live-Birth
HEDIS 2000 Technical Specifications, Volume 2, p. 72


E6-B Step 3 (2nd step): Of Cases Identified
2, Mother's Diagnoses Which Confirm
ive Birth Outcome
E6-B Step 4 (3rd step): Of Cases Identified
2, E&M Codes & DRGs for Newborn Which
m Live Birth Outcome
HEDIS 2000 Technical Specifications, Volume 2, p. 72


-of-Delivery Linkage to a Revenue
Which Indicates a Nursery or NICU
With Matching Date of Service
-of-Delivery Linkage to a Matching
ly/Case Grouping Member's Date-of-


All Deliveries Identified Via Table E6-B
2, which Remain Unconfirmed by a
ily/Case Match for Date-of-Birth, or
born Revenue Code Date-of-Service
dentify Multiple Deliveries in 1999
firmation Performed by MIS Claims
itor

QUALITY 2000: Meeting the Challenge
Conference Evaluation

Shade circles like this→ ● Not like this→ ⊗ ✓

HSAG Health Services Advisory Group INC.

9172292743

2/23/2000 v4
For Questions, (602) 264-6382

CY

Luncheon Presentation	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
Proven Strategies to Improve Vaccination Coverage					
M. Was this topic helpful to your daily job?	○	○	○	○	○
N. Did the speaker have good command of the material?	○	○	○	○	○
O. Did the speaker deliver the talk in a way that was conducive to learning?	○	○	○	○	○

Afternoon Concurrent Presentations	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
The 1999 HEDIS Experience - Challenges and Practices					
P. Was this topic helpful to your daily job?	○	○	○	○	○
Q. Did the speakers have good command of the material?	○	○	○	○	○
R. Did the speakers deliver the talk in a way that was conducive to learning?	○	○	○	○	○
Best Practices: Managed Care Quality Profiles					
S. Was this topic helpful to your daily job?	○	○	○	○	○
T. Did the speaker have good command of the material?	○	○	○	○	○
U. Did the speaker deliver the talk in a way that was conducive to learning?	○	○	○	○	○

Overall	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
V. Do you feel the objectives of today's conference were met?	○	○	○	○	○
W. Were the facility and location appropriate for this conference?	○	○	○	○	○

COMMENTS: _____

QUALITY 2000: Meeting the Challenge
Conference Evaluation

Shade circles like this→ ● Not like this→ ⊗ ✓

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2/23/2000 v4
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9492292748

CY

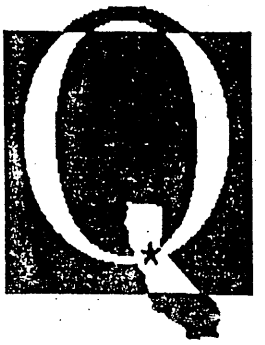
Program Objectives

- Understand the QI initiatives of the Health Care Financing Administration (HCFA)
- Understand the protocol requirements for External Quality Review Organizations as established by HCFA
- Know the National Medicaid Database facts and availability
- Understand the Practical Implications of Evidence Based Medicine
- Understand Childhood Immunization interventions and how they work
- Understand the HEDIS Audit experience from the perspective of the auditor
- Take home Quality Improvement Strategies and best practices from the Managed Care Organizations

Please take a moment to complete this evaluation survey. Fill in the circle that best describes your evaluation of the program based on the following statements.

General Session Presentations	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
EQRO Requirements and Protocol					
A. Was this topic helpful to your daily job?	○	○	○	○	○
B. Did the speaker have good command of the material?	○	○	○	○	○
C. Did the speaker deliver the talk in a way that was conducive to learning?	○	○	○	○	○
The National Medicaid HEDIS Database					
D. Was this topic helpful to your daily job?	○	○	○	○	○
E. Did the speaker have good command of the material?	○	○	○	○	○
F. Did the speaker deliver the talk in a way that was conducive to learning?	○	○	○	○	○
Evidence Based Medicine: What are the Practical Implications?					
G. Was this topic helpful to your daily job?	○	○	○	○	○
H. Did the speaker have good command of the material?	○	○	○	○	○
I. Did the speaker deliver the talk in a way that was conducive to learning?	○	○	○	○	○
Challenges and Opportunities for Quality Improvement in Medi-Cal Managed Care					
J. Was this topic helpful to your daily job?	○	○	○	○	○
K. Did the speaker have good command of the material?	○	○	○	○	○
L. Did the speaker deliver the talk in a way that was conducive to learning?	○	○	○	○	○

Slide Notes For



Evidence Based Medicine: What are the Practical Implications?

David M. Eddy, MD, PhD
Senior Advisor,
Health Policy and Management
Kaiser Permanente, Southern California

Evidence-based Medicine: What are the Practical Implications?

Quality 2000: Meeting the Challenge

February 28, 2000
David M. Eddy MD, Ph.D
Kaiser Permanente Southern California

Evidence-based medicine: Six questions

- What it is
- What it is not
- Why it is not a new idea
- Why it is a new idea
- Why we need to do it
- Implications for the practice of medicine

What evidence-based medicine is: an academic definition

- The conscientious, explicit and judicious use of current best evidence in making clinical decisions about the care of individual patients.
- It means integrating individual clinical experience with the best available clinical evidence from systematic research

What evidence-based medicine is: a practical definition

- When there is evidence of benefit and value, do it.
- When there is evidence of no benefit, harm, or poor value, don't do it.
- When there is insufficient evidence to know for sure, be conservative
- (And whatever you do, do it right)

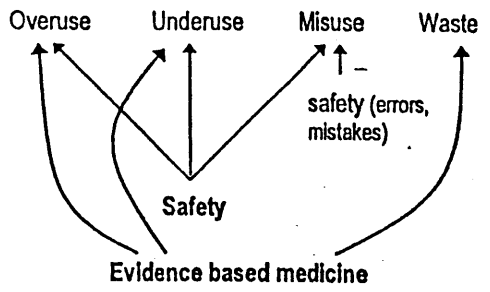
Evidence based medicine: the motivation

- Improve quality
  - Make sure people get things that will help them
  - Make sure they do not get things that will hurt them or do them no good
- Use people's money responsibly

What evidence-based medicine is not

- Refusal to cover any treatment that is not supported by perfect evidence
  - (eg multiple randomized controlled trials)

A brief taxonomy



What evidence-based medicine is: a practical definition

- When there is evidence of benefit and value, do it.
- When there is evidence of no benefit, harm, or poor value, don't do it.
- When there is insufficient evidence to know for sure, be conservative
- (And whatever you do, do it right)

What we mean by "Do it"

- Cover it
- Design affirmative guidelines, disease management programs, best practices ..
- Provide decision support
- Create performance measures
- Possibly a strategic goal
- Develop CQI projects

Examples of "Do it"?

- Aspirin, beta blockers, streptokinase for acute MI
- ACE inhibitors for acute MI and heart failure
- Cardiac rehabilitation after MI
- Cholesterol and blood pressure control in high risk people
- Sterile technique in the OR

What we mean by "Don't do it"

- Negative guidelines, disease management ...
- Negative decision support
- Negative performance measures
- Not a strategic goal
- Negative CQI
- Don't cover

Examples of "Don't do it"

- Class I antiarrhythmics for secondary prevention after heart attacks
- Erythropoietin to maintain normal hematocrit (42%) in ESRD
- Prophylactic removal of asymptomatic impacted wisdom teeth
- Calcium channel blockers for heart attacks if left ventricular function is reduced
- Routine antibiotics for sore throats

What we mean by "Be conservative"?

- If it's a new treatment
  - Recommend only within well designed trials
- If it's an old treatment
  - Make available as an option (physician discretion), but
  - Do not include in affirmative guidelines, disease management strategies, performance measures, CQI, etc.
  - If there are important harms or high costs, discourage it.

Examples of "Be conservative"

- Recommend only within well designed trials
  - High dose chemotherapy and bone marrow transplant for stage IV breast cancer
- OK to do, but no affirmative guidelines
  - Screen for diabetes
  - Screen for primary open angle glaucoma
- Discourage
  - Radical mastectomy for early stage breast cancer

Why be so strict with new treatments?

- "Promising" does not mean "effective"; the treatment may be ineffective or harmful
- We are often fooled
- Premature coverage kills the ability and incentive to do the research needed to determine if a treatment is effective
  - "If we don't know a treatment's effectiveness at the time of coverage, we never will"
- Money spent on ineffective treatments is not available for other treatments

An example: HDC/ABMT for metastatic breast cancer

- The need, the hope
- The theory: more is better
- The intermediate outcomes: complete and partial disappearance of tumors on x-ray
- Anecdotes of "cures"
- Clinical series and historical comparisons appear favorable
- Well controlled trials show no effect, higher toxicity

NCI's trial of HDC/ABMT for metastatic disease: 199 patients

	ABMT	CME
3-Year survival	32%	38%
Anemia	69%	6%
Infections	31%	2%

CALGB/ABMTR registry analysis of HDC/ABMT for metastatic disease: 1301 patients

	ABMT	CME
Median survival	1.77 years	1.83 years

The only positive study (Bezwoda) has been discredited

- One study had positive results, "prompting believers in the therapy to cling to hope that this arduous treatment might work in some circumstances."
- Johannesburg's University of Witwatersrand announced that that study now "is discredited."
- "This was done out of a foolish desire to make the presentation more acceptable to an audience of cancer experts", the author said.

What happened?

- Enthusiasm ⟷ Desire
- "Investigational" = "New" = "Cutting edge" = "Better"
- Underestimation of cofactors
  - A patient's outcomes (e.g. survival) are determined as much by other (non-treatment) factors as they are by the treatment
  - Other factors have as big an effect on survival as the treatment
- Over-interpretation of biological outcomes
- It is easy to be fooled

It is easy to be fooled: some recent cases

- High dose chemotherapy and bone marrow transplant for breast cancer
- Anti arrhythmics for heart attacks
- Treatment of ingested poisons
- Epoietin for anemia in end stage renal disease
- Hormone replacement therapy for heart disease
- Treatment of hyponatremic encephalopathy

Why evidence-based medicine is not new

- "First do no harm"
- The scientific tradition
- NIH and clinical research
- Hypothesis testing
- Informed decision making
- The Pure Food and Drug Act, and FDA's approval to market
- Common sense: do things that work, don't do things that don't work

Why evidence-based medicine *is* new

- We (the world) don't do it

Why we need to promote evidence based medicine

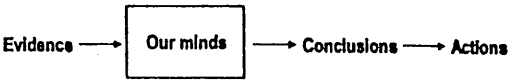
- We (the world) have a very important quality problem in medicine
  - It's not managed care
  - It's traditional, *laissez faire*, care
- An unacceptably large proportion of medicine is not practiced in accordance with existing evidence
- Correcting this quality problem will require a "return to the basics" – evidence

If evidence is not the anchor, what is? Alternatives to evidence-based medicine

- Judgments of individual physicians
  - "Clinical judgment"
- Consensus of a group of physicians
  - Panel of experts
- Actions of the majority of physicians
  - "Community standard"
  - "Standard and accepted practice"

The alternatives to evidence based medicine are based on a crucial assumption

"Our minds are interpreters of evidence. We can accurately convert all forms of evidence" (formal evidence, observations, experiences, colleagues' experiences) into conclusions, which in turn determine our actions



"Therefore, no one has to tell us what to do. Just give us the evidence and we'll figure it out. Besides there are a lot of other factors that need to be considered."

In fact we are not very good at converting evidence into accurate beliefs and actions

- Complexity of medical practice
- Complexity of research
- Limitations of the human mind
- Personal & professional biases

- Wide variations in perceptions
- Wide variations in practices
- High rates of inappropriate care

A woman asks her physician about the pros and cons of taking a drug for osteoporosis

- Why should I do this?
- What is my risk of having a hip fracture in the coming year?
- How will taking the drug decrease my risk of a fracture?

Suppose this woman is 55 years old, thin, a smoker, has no personal or family history of fractures, and has a lower than average bone mineral density (Z-score = -1).

	Risk factor
55 years old	?
Thin	?
Smoker	?
no personal history of fractures	?
no family history of fractures	?
Z-score = -1	?

Suppose this woman is 55 years old, thin, a smoker, has no personal or family history of fractures, and has a lower than average bone mineral density (Z-score = -1).

	Risk factor
55 years old	0.00048
Thin	0.94
Smoker	1.43
no personal history of fractures	1.22
no family history of fractures	1.29
Z-score = -1	2.3

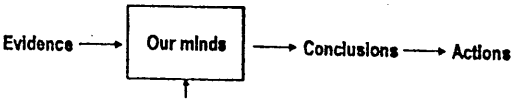
An example of the complexity of medical decision-making

- 0.00048 * 0.94 * 1.43 * 1.22 * 1.29 * 2.3 = .00234
- You buy 27 pencils @ 17 cents each. How much do you pay the cashier?

An example of the complexity of medical decision-making

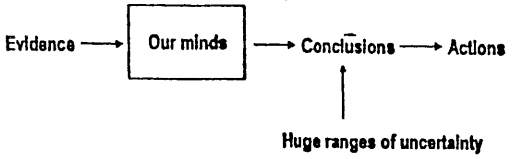
- You buy 27 pencils @ 17 cents each.
  27 x 17 = $4.59
- You buy 10 pencils at 17 cents each = ?

Other factors that affect our decisions.



Professional interests
Financial interests
Personal tastes
Desire to have *something* to offer
Wishful thinking
Selective memory
Pressure from patients and family,
Too busy, not enough time
Forgot

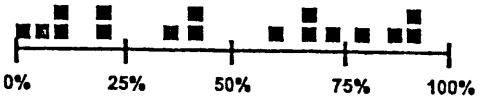
What about the conclusions?



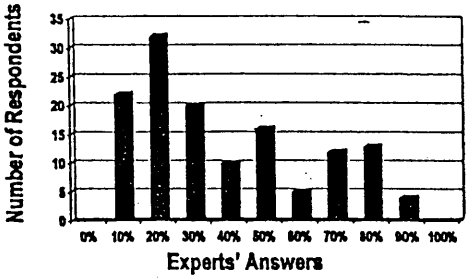
Experts estimates of the chance of a spontaneous rupture of a silicone breast implant

0% 0.2% 0.5% 1% 1% 1% 1.5% 1.5% 2% 3%
3% 4% 5% 5% 5% 5% 5% 5% 5% 6% 6%
6% 8% 10% 10% 10% 10% 13% 13% 15%
15% 18% 20% 20% 20% 25% 25% 25% 30%
30% 40% 50% 50% 50% 62% 70% 73% 75%
75% 75% 75% 80% 80% 80% 80% 80% 80%
100%

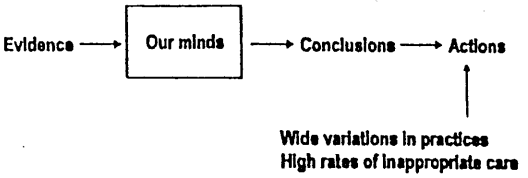
Experts estimates of the effect of colon cancer screening on chance of dying



Experts' estimates of probability of acute retention in men with BPH



What about the actions?



Wide variations in practices

- A Medline search for "wide variations in practices" pulled up 25,000 articles: three random examples
  - Use of ACE inhibitors in patients with CHF varied by a factor of 2 across specialties
  - Calculations of standardized radiation dosage for interstitial brachytherapy for prostate cancer varied by a factor of 2.5
  - Recommendations of preventive practices for patients with cardiovascular disease varied by a factor of 27 across specialties

High rates of inappropriate care

- ACE inhibitors for CHF
- Drug use - General (contra indicated prescriptions)
- Antibiotics
- Coronary angiography Bypass surgery and angioplasty
- Carotid endarterectomies
- Tympanostomy tubes
- Lyme disease treatment
- Radiology for low back pain
- Laparoscopic cholecystectomy
- Cesarean sections
- Hysterectomies
- Upper GI endoscopy
- Hemodialysis (grafts vs. fistulae)
- Surgery (many kinds)

High rates of inappropriate care

- Carotid endarterectomy for symptomatic disease
- Anticoagulants for atrial fibrillation
- Hypertension (recognition & treatment)
- Congestive heart failure (use of ACE inhibitors)
- Myocardial infarctions (use of aspirin, thrombolytics, β blockers)
- Endocarditis (prophylactics)
- Diabetes management (glucose control, renal function, lipid levels)
- Ophthalmic disease
- Ulcers (treatment of H pylori)
- Asthma (use of inhaled corticoid steroids)
- AIDS-associated P carinii pneumonia

High rates of inappropriate care

- Breast cancer (breast conserving surgery)
- Dying (end of life concerns, remediable suffering)
- Pain control (dosing of analgesics)
- Depression (recognition and treatment)
- Functional disability
- Immunizations
- Cancer screening
- Health counseling (e.g., diet, exercise, stress)
- Vaccinations (missed opportunities, erroneous contraindications)
- Alcohol and drug abuse (identification, treatment)
- Smoking cessation
- Domestic Violence (identification)

The take home messages

- We can't count on clinical or expert judgment to "know" what is right (effective)
  - Therefore we need to do the research
- Even when there is evidence, we can't count on practitioners to do what the evidence shows
  - Therefore we need to support their decisions
  - "clinical management"
- This is no one's fault; medicine is too complex for the unaided human mind

Implications for the practice of medicine

- We (the world) have a huge quality problem
- The "laissez faire" approach of leaving decisions entirely to the judgments of the individual treating physicians, without decision support, results in wide variations in practices and high rates of inappropriate care
- Correcting this problem requires "clinical management"; aggressive decision support and peer support
- Without clinical management, care is highly variable and often inappropriate

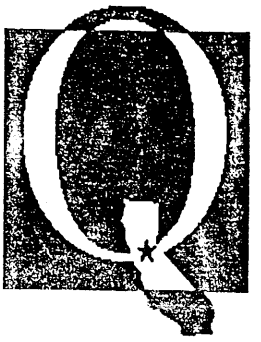
Correcting this problem requires "clinical management"

- "Management"
  - Guidelines, disease management, best practices, on-line decision support, ...
- "Clinical"
  - Designed by people with knowledge of medical science, evidence, patients' needs and expectations, how medicine is practiced
  - But using evidence, not unsupported subjective judgments

Implications for legislators

- Support clinical management
  - "Laissez faire" medicine produces bad quality - overuse, under-use and waste
  - Correcting these problems requires clinical management
- Practice evidence-based medicine
  - Avoid practicing medicine at all
  - But if you must, make it evidence-based, not vote-based or anecdote-based

Slide Notes For



Quality 2000:
The Federal Challenge

Ann Page, RN, MPH
Technical Director of the Division of Quality Systems Management
Health Care Financing Administration

Quality 2000:
the FEDERAL Challenge

Ann Page RN, MPH
Technical Director
Division of Quality System Management
Center for Medicaid and State Operations, HCFA

Growing Federal Emphasis on:

1. Beneficiary rights and protections
2. Quantitative information on Medicaid managed care
3. Populations with special health care needs

Challenges evident in multiple HCFA directives/guidance:

- Medicaid proposed rules on managed care
- Medicaid proposed rules on external quality review of MCOs
- Report to Congress
- Administrative actions
- Technical assistance products

1. Beneficiary Rights & Protections

Managed care NPRM would require PHPs/ some HIOs to meet most of the same standards as MCOs, including:

- beneficiary information and education
- adequate capacity of providers and services
- consumer Bill of Rights protections
- provisions for continuity of care
- grievance and appeal procedures

Beneficiary information/education

- State determination of prevalent language(s)
- Inform beneficiaries in prevalent language(s)
- Translation services
- Provision of certain information; e.g., benefits, procedures for obtaining services, providers, rights, et al.

Adequate providers and services

- States to ensure that MCO provider networks are sufficient in "number, mix, and geographic distribution"
- cultural competence
- emergency and stabilization services

Grievance and appeal procedures

2. Populations with special health care needs

- BBA NPRM would require MCOs to timely identify and assess individuals with increased health care needs
- Interim criteria for review of waivers
- BBA-required report on safeguards for Medicaid beneficiaries enrolled in MCOs

Balanced Budget Act of 1997:

- *"The Secretary of HHS. . . shall conduct a study concerning the safeguards (if any) that may be needed to ensure that the health care needs of individuals with special health care needs and chronic conditions who are enrolled in Medicaid managed care organizations are adequately met."*

Target Populations

- children with special health care needs
- children in foster care
- people with serious or persistent mental illness
- older adults (65+) with disability/ chronic conditions
- non-aged adults with disability / chronic conditions
- homeless

Important Medicaid Issues

- Identification of enrollees with special health care needs
- Stakeholder education and involvement
- Matching services to needs
- Coordination and continuity of care
- Experienced providers
- Quality monitoring

Identification of enrollees with special health care needs

- Some tools developed; e.g. QuICCC
- Need for other screening tools
- Use of Medicaid FFS or MCO encounter /claims data

Stakeholder Involvement

- Deming: "The consumer is the most important part of the production line... Quality should be aimed at the needs of the consumer - present and future."
- Evidence base for consumer involvement is strong
- Other production partners
- Stakeholder education
- Some consumers need assistance to be involved

Addressing Service Needs

- Beneficiary assessment
- Flexibility in Medicaid benefits and MCO "value-added" services
- Medical necessity determinations
- Technology assessments

Access to Experienced Providers

- Experienced providers as new paradigm
- Evidence base
- Challenges to adequate provider networks:
  - unpredictable need
  - lack of quantifiable standards
  - geographic maldistribution
  - manpower shortages
  - lack of criteria for "experience"
  - subjective nature of need

Coordination and Continuity

- Weak evidence base
- Responsibility without authority
- Need for further research
- Can logic and reason alone suffice ?????

Monitoring Quality - Processes & Outcomes

Challenges:
- identification
- small numbers
- multiple conditions and risk factors
- influence of nonmedical factors and care

3. Quantitative information on Medicaid managed care

- State Quality Assessment and Performance Improvement Strategy
- Independent, external quality review
- Medicaid HEDIS data base
- Increasing interest in encounter data by States and HCFA

State Quality Assessment/ Performance Improvement Strategy

- Contract provisions/monitoring for: access, structure & operations, and quality measurement and improvement
- External, independent quality review
- Intermediate sanctions
- Information systems

Contract provisions to include:

- Practice guidelines
- Use of performance measures/benchmarks
- Performance improvement projects with demonstrable and sustained improvements
- MCO health information systems requirements

External Quality Review

- "The analysis ...of aggregated information on timeliness, access and quality of health care services furnished to Medicaid recipients by each MCO . . . ."

December 1,1999 NPRM

External Quality Review

- Mandatory sources of information
  - compliance with structural standards
  - MCO performance improvement projects
  - validated performance measures
- Optional sources of information
  - surveys
  - encounter data
  - other performance measures, quality projects

External Quality Review

- Non-duplication of certain activities
- exemption from EQR
- EQR report

Medicaid HEDIS data base

- Grant from Commonwealth fund to American Public Human Services Assn.
- subcontract w/ NCQA
- Steering committee: States, HCFA, APHSA, NCQA, one researcher
- Two years of data ('97 &'98) on nine quality of care measures
- in '98 an estimated 181 plans in 31 States

Medicaid HEDIS data base

- Measures:
  - immunizations -childhood & adolescent
  - cervical cancer screening
  - check-ups after delivery
  - diabetic eye exams
  - child access to primary care providers - 3 ages
  - inpatient hospitalization utilization rate

Medicaid HEDIS data base

- Calculate means and median for nine measures
- National rates
- Data base owned by APHSA.
- Access to data base by permission of Steering Committee

Encounter data

- Needed for management, quality oversight and study
- Most States collecting
- Lack of standardization
- Not always at the Federal level
- Need for validation
- How to make collection of encounter data more useful?

Federal Challenges -Summary

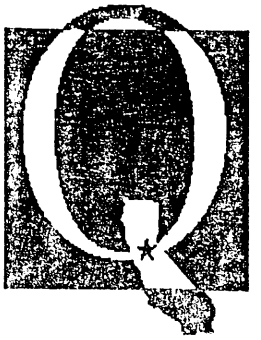
1. Continued adaptability
2. Increased technical knowledge and skills
3. Ability to cope with being ahead of the curve

Structural Quality Measures

- "Increase or decrease the probability of good performance . . .
- Probably the most important means of protecting and promoting quality of care. . .
- A blunt instrument for assessing quality."

Avedis Donabedian, 1966

Slide Notes For



Evidence Based Medicine: What are the Practical Implications?

David M. Eddy, MD, PhD
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Evidence-based Medicine: What are the Practical Implications?

Quality 2000: Meeting the Challenge

February 28, 2000
David M. Eddy MD, Ph.D
Kaiser Permanente Southern California

Evidence-based medicine: Six questions

- What it is
- What it is not
- Why it is not a new idea
- Why it is a new idea
- Why we need to do it
- Implications for the practice of medicine

What evidence-based medicine is: an academic definition

- The conscientious, explicit and judicious use of current best evidence in making clinical decisions about the care of individual patients.
- It means integrating individual clinical experience with the best available clinical evidence from systematic research

What evidence-based medicine is: a practical definition

- When there is evidence of benefit and value, do it.
- When there is evidence of no benefit, harm, or poor value, don't do it.
- When there is insufficient evidence to know for sure, be conservative
- (And whatever you do, do it right)

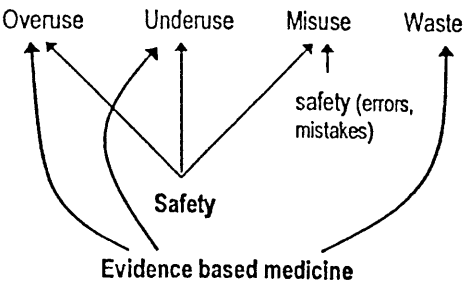
Evidence based medicine: the motivation

- Improve quality
  - Make sure people get things that will help them
  - Make sure they do not get things that will hurt them or do them no good
- Use people's money responsibly

What evidence-based medicine is not

- Refusal to cover any treatment that is not supported by perfect evidence
  - (eg multiple randomized controlled trials)

A brief taxonomy



What evidence-based medicine is: a practical definition

- When there is evidence of benefit and value, do it.
- When there is evidence of no benefit, harm, or poor value, don't do it.
- When there is insufficient evidence to know for sure, be conservative
- (And whatever you do, do it right)

What we mean by "Do it"

- Cover it
- Design affirmative guidelines, disease management programs, best practices ...
- Provide decision support
- Create performance measures
- Possibly a strategic goal
- Develop CQI projects

Examples of "Do it"?

- Aspirin, beta blockers, streptokinase for acute MI
- ACE inhibitors for acute MI and heart failure
- Cardiac rehabilitation after MI
- Cholesterol and blood pressure control in high risk people
- Sterile technique in the OR

What we mean by "Don't do it"

- Negative guidelines, disease management ...
- Negative decision support
- Negative performance measures
- Not a strategic goal
- Negative CQI
- Don't cover

Examples of "Don't do it"

- Class I antiarrhythmics for secondary prevention after heart attacks
- Erythropoietin to maintain normal hematocrit (42%) in ESRD
- Prophylactic removal of asymptomatic impacted wisdom teeth
- Calcium channel blockers for heart attacks if left ventricular function is reduced
- Routine antibiotics for sore throats

What we mean by "Be conservative"?

- If it's a new treatment
  - Recommend only within well designed trials
- If it's an old treatment
  - Make available as an option (physician discretion), but
  - Do not include in affirmative guidelines, disease management strategies, performance measures, CQI, etc.
  - If there are important harms or high costs, discourage it.

Examples of "Be conservative"

- Recommend only within well designed trials
  - High dose chemotherapy and bone marrow transplant for stage IV breast cancer
- OK to do, but no affirmative guidelines
  - Screen for diabetes
  - Screen for primary open angle glaucoma
- Discourage
  - Radical mastectomy for early stage breast cancer

Why be so strict with new treatments?

- "Promising" does not mean "effective"; the treatment may be ineffective or harmful
- We are often fooled
- Premature coverage kills the ability and incentive to do the research needed to determine if a treatment is effective
  - "If we don't know a treatment's effectiveness at the time of coverage, we never will"
- Money spent on ineffective treatments is not available for other treatments

An example: HDC/ABMT for metastatic breast cancer

- The need, the hope
- The theory: more is better
- The intermediate outcomes: complete and partial disappearance of tumors on x-ray
- Anecdotes of "cures"
- Clinical series and historical comparisons appear favorable
- Well controlled trials show no effect, higher toxicity

NCI's trial of HDC/ABMT for metastatic disease: 199 patients

	ABMT	CME
3-Year survival	32%	38%
Anemia	69%	6%
Infections	31%	2%

CALGB/ABMTR registry analysis of HDC/ABMT for metastatic disease: 1301 patients

	ABMT	CME
Median survival	1.77 years	1.83 years

The only positive study (Bezwoda) has been discredited

- One study had positive results, "prompting believers in the therapy to cling to hope that this arduous treatment might work in some circumstances."
- Johannesburg's University of Witwatersrand announced that that study now "is discredited."
- "This was done out of a foolish desire to make the presentation more acceptable to an audience of cancer experts", the author said.

What happened?

- Enthusiasm ⟷ Desire
- "Investigational" = "New" = "Cutting edge" = "Better"
- Underestimation of cofactors
  - A patient's outcomes (e.g. survival) are determined as much by other (non-treatment) factors as they are by the treatment
  - Other factors have as big an effect on survival as the treatment
- Over-interpretation of biological outcomes
- It is easy to be fooled

It is easy to be fooled: some recent cases

- High dose chemotherapy and bone marrow transplant for breast cancer
- Anti arrhythmics for heart attacks
- Treatment of ingested poisons
- Epoietin for anemia in end stage renal disease
- Hormone replacement therapy for heart disease
- Treatment of hyponatremic encephalopathy

Why evidence-based medicine is not new

- "First do no harm"
- The scientific tradition
- NIH and clinical research
- Hypothesis testing
- Informed decision making
- The Pure Food and Drug Act, and FDA's approval to market
- Common sense: do things that work, don't do things that don't work

Why evidence-based medicine *is* new

- We (the world) don't do it

Why we need to promote evidence based medicine

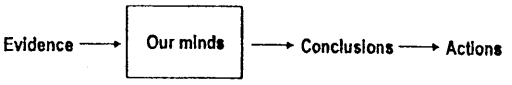
- We (the world) have a very important quality problem in medicine
  - It's not managed care
  - It's traditional, *laissez faire*, care
- An unacceptably large proportion of medicine is not practiced in accordance with existing evidence
- Correcting this quality problem will require a "return to the basics" – evidence

If evidence is not the anchor, what is? Alternatives to evidence-based medicine

- Judgments of individual physicians
  - "Clinical judgment"
- Consensus of a group of physicians
  - Panel of experts
- Actions of the majority of physicians
  - "Community standard"
  - "Standard and accepted practice"

The alternatives to evidence based medicine are based on a crucial assumption

"Our minds are interpreters of evidence. We can accurately convert all forms of evidence" (formal evidence, observations, experiences, colleagues' experiences) into conclusions, which in turn determine our actions



"Therefore, no one has to tell us what to do. Just give us the evidence and we'll figure it out. Besides there are a lot of other factors that need to be considered."

In fact we are not very good at converting evidence into accurate beliefs and actions

- Complexity of medical practice
- Complexity of research
- Limitations of the human mind
- Personal & professional biases

- Wide variations in perceptions
- Wide variations in practices
- High rates of inappropriate care

A woman asks her physician about the pros and cons of taking a drug for osteoporosis

- Why should I do this?
- What is my risk of having a hip fracture in the coming year?
- How will taking the drug decrease my risk of a fracture?

Suppose this woman is 55 years old, thin, a smoker, has no personal or family history of fractures, and has a lower than average bone mineral density (Z-score = -1).

	Risk factor
55 years old	?
Thin	?
Smoker	?
no personal history of fractures	?
no family history of fractures	?
Z-score = -1	?

Suppose this woman is 55 years old, thin, a smoker, has no personal or family history of fractures, and has a lower than average bone mineral density (Z-score = -1).

	Risk factor
55 years old	0.00048
Thin	0.94
Smoker	1.43
no personal history of fractures	1.22
no family history of fractures	1.29
Z-score = -1	2.3

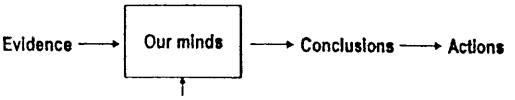
An example of the complexity of medical decision-making

- 0.00048 * 0.94 * 1.43 * 1.22 * 1.29 * 2.3 = .00234
- You buy 27 pencils @ 17 cents each. How much do you pay the cashier?

An example of the complexity of medical decision-making

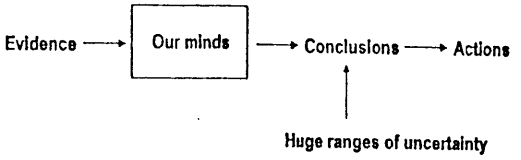
- You buy 27 pencils @ 17 cents each.
  27 x 17 = $4.59
- You buy 10 pencils at 17 cents each = ?

Other factors that affect our decisions.



Professional interests
Financial interests
Personal tastes
Desire to have *something* to offer
Wishful thinking
Selective memory
Pressure from patients and family,
Too busy, not enough time
Forgot

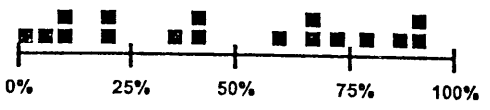
What about the conclusions?



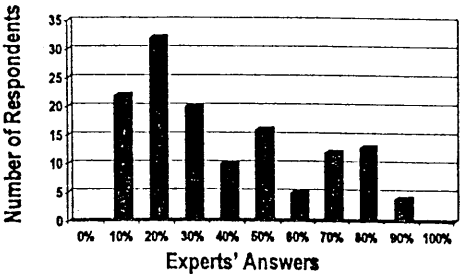
Experts estimates of the chance of a spontaneous rupture of a silicone breast implant

0% 0.2% 0.5% 1% 1% 1% 1.5% 1.5% 2% 3%
3% 4% 5% 5% 5% 5% 5% 5% 5% 6% 6%
6% 8% 10% 10% 10% 10% 13% 13% 15%
15% 18% 20% 20% 20% 25% 25% 25% 30%
30% 40% 50% 50% 50% 62% 70% 73% 75%
75% 75% 75% 80% 80% 80% 80% 80% 80%
100%

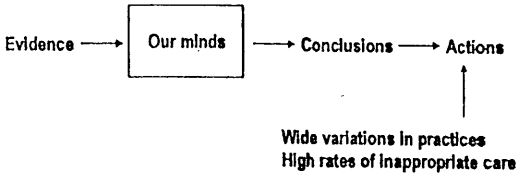
Experts estimates of the effect of colon cancer screening on chance of dying



Experts' estimates of probability of acute retention in men with BPH



What about the actions?



Wide variations in practices

- A Medline search for "wide variations in practices" pulled up 25,000 articles: three random examples
  - Use of ACE inhibitors in patients with CHF varied by a factor of 2 across specialties
  - Calculations of standardized radiation dosage for interstitial brachytherapy for prostate cancer varied by a factor of 2.5
  - Recommendations of preventive practices for patients with cardiovascular disease varied by a factor of 27 across specialties

High rates of inappropriate care

- ACE inhibitors for CHF
- Drug use - General (contra indicated prescriptions)
- Antibiotics
- Coronary angiography Bypass surgery and angioplasty
- Carotid endarterectomies
- Tympanostomy tubes
- Lyme disease treatment
- Radiology for low back pain
- Laparoscopic cholecystectomy
- Cesarean sections
- Hysterectomies
- Upper GI endoscopy
- Hemodialysis (grafts vs. fistulae)
- Surgery (many kinds)

High rates of inappropriate care

- Carotid endarterectomy for symptomatic disease
- Anticoagulants for atrial fibrillation
- Hypertension (recognition & treatment)
- Congestive heart failure (use of ACE inhibitors)
- Myocardial Infarctions (use of aspirin, thrombolytics, β blockers)
- Endocarditis (prophylactics)
- Diabetes management (glucose control, renal function, lipid levels)
- Ophthalmic disease
- Ulcers (treatment of H pylori)
- Asthma (use of inhaled corticoid steroids)
- AIDS-associated P carinii pneumonia

High rates of inappropriate care

- Breast cancer (breast conserving surgery)
- Dying (end of life concerns, remediable suffering)
- Pain control (dosing of analgesics)
- Depression (recognition and treatment)
- Functional disability
- Immunizations
- Cancer screening
- Health counseling (e.g., diet, exercise, stress)
- Vaccinations (missed opportunities, erroneous contraindications)
- Alcohol and drug abuse (identification, treatment)
- Smoking cessation
- Domestic Violence (identification)

The take home messages

- We can't count on clinical or expert judgment to "know" what is right (effective)
  - Therefore we need to do the research
- Even when there is evidence, we can't count on practitioners to do what the evidence shows
  - Therefore we need to support their decisions
  - "clinical management"
- This is no one's fault; medicine is too complex for the unaided human mind

Implications for the practice of medicine

- We (the world) have a huge quality problem
- The "laissez faire" approach of leaving decisions entirely to the judgments of the individual treating physicians, without decision support, results in wide variations in practices and high rates of inappropriate care
- Correcting this problem requires "clinical management"; aggressive decision support and peer support
- Without clinical management, care is highly variable and often inappropriate

Correcting this problem requires "clinical management"

- "Management"
  - Guidelines, disease management, best practices, on-line decision support, ...
- "Clinical"
  - Designed by people with knowledge of medical science, evidence, patients' needs and expectations, how medicine is practiced
  - But using evidence, not unsupported subjective judgments

Implications for legislators

- Support clinical management
  - "Laissez faire" medicine produces bad quality - overuse, under-use and waste
  - Correcting these problems requires clinical management
- Practice evidence-based medicine
  - Avoid practicing medicine at all
  - But if you must, make it evidence-based, not vote-based or anecdote-based

1 Challenges and Opportunities for Quality Improvement in Medi-Cal Managed Care

2 Challenges and Opportunities for Quality Improvement in Medi-Cal Managed Care

- The case for quality improvement
- Challenges to quality improvement
- Building for the future

3 Goals of Medi-Cal Managed Care

- Use market mechanisms
  - choice
  - competition
- Population based care management
- Rationalize allocation of resources
- Increase access to high quality, affordable care

4 The Clinical Case for Quality Improvement

- Provide better care for patients
- Improve the health status of a population

5 The Business Case for Quality Improvement

- Manage risk — reduce legal liability
- Meet regulatory requirements — stay in business

6 The Business Case for Quality Improvement

- Improve customer satisfaction - retain members
- Recruit new members
- Improve operational efficiency - lower administrative and medical costs

7 The Rise of Consumerism

- "The irresistible force meets the previously immovable object."
- The market will become more, not less, competitive
- Consumers will drive efforts to improve and demonstrate Quality in health care.

8 The Rise of Consumerism

- Commercial plans are becoming more consumer friendly
  - Direct access to specialists
  - Access to out of network providers

- Online services replacing waiting on hold

9 Listening to the voice of the Medi-Cal Consumer: MCPI Beneficiary Survey

- First statewide survey of beneficiaries
  - Quality of care and access
  - Barriers to enrollment
  - Different ethnic groups
  - Managed Care versus FFS

10 Understanding the Potential Medi-Cal Consumer: MCPI Marketing Survey

- Survey of persons eligible but not enrolled in Medi-Cal and Healthy Families
- Learn more about their beliefs and preferences

11 Challenges to Quality Improvement

- Insufficient resources to invest in QI
- Lack of staff expertise — clinical and analytic
- Lack of organizational commitment

12 Medicaid Plans Lack Profits

- 60% lost money, 8% broke even
- 86% of profitable plans had >25,000 members
- 11% of profitable plans had only Medicaid membership

13 Small Plans Lack Economies of Scale

- A 50,000 member plan needs the same quality infrastructure as a 500,000 member plan
  - Information systems
  - Staff

14 Medi-Cal Plans

- Alameda Alliance for Health 77,877
- San Francisco Health Plan 21,922
- Contra Costa 41,438
- San Mateo 41,310
- Santa Barbara 36,827
- San Joaquin 52,460
- Riverside 74,628

15 Challenges in Collecting and Using Data

- Inadequate information systems
- Sub-optimal provider cooperation and capabilities
  - 3-5% of HEDIS data collected in 1999 came from administrative data Vs. chart review

16 MCPI Data Mapping Survey

- Mapping encounter and claims data from providers to health plans to DHS
- Assessing information systems at provider groups
- Results will be available in April

17 Challenges in Collecting and Using Data

- Unstable membership
- Small membership and low response rates to surveys
  - Difficult to achieve statistical significance

18 MCPI Studies of Continuous Enrollment

- Analysis of the costs of guaranteed eligibility in Medicaid managed care
- Analysis of the impact of locking members into Medicaid managed care plans

19 Building for the Future

- Diversify product lines and grow membership to achieve economies of scale
  - Healthy Families
  - HIPIC
- Use Quality Improvement to improve member recruitment and retention

20 Building for the Future

- Collaborate with other plans
  - Joint data collection (CCHRI)
  - Joint QI projects
- Share systems and resources with other plans
- Consolidate with other plans

21 Building for the Future

- Leverage new cost-efficient technologies
  - Application Service Providers
- Support streamlined oversight and quality measurement

22 Building for the Future

- Encourage and use quality measures in contracting and monitoring providers
  - Patient Evaluation of Performance in California (PEP-C) for hospitals

- Physician Value Check (Pacific Business Group on Health) for provider groups

23 ## Building for the Future

- Select quality improvement projects that will have high impact for members and providers.
  - Monitor and improve access
  - Improve cultural competence
  - Deliver CME for providers

24 ## Prepare for Public Release of Plan Report Cards

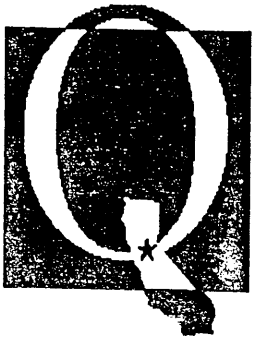
- Medicaid Plans Quality Reporting*
  - 60% Collect all or most HEDIS data
  - 5% Have one year NCQA accreditation
  - 60% Plan to seek NCQA accreditation

25 ## Build for the Future

- Technical Assistance from Christine Thurston at NCQA
- CAHPS survey in multiple languages - Spanish, Vietnamese, Cantonese, Cambodian, Korean

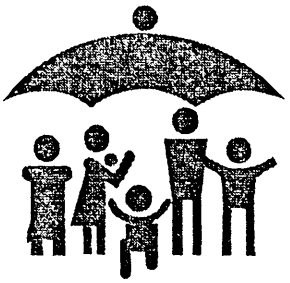
26

Slide Notes For



Proven Strategies to Raise Immunization Coverage Levels

Lance E. Rodewald, MD
Associate Director of Science
Immunization Services Division
Centers for Disease Control and Prevention



The National Immunization Program
Leading the Way to Healthy Lives!

CDC

Proven Strategies to Raise Immunization Coverage Levels

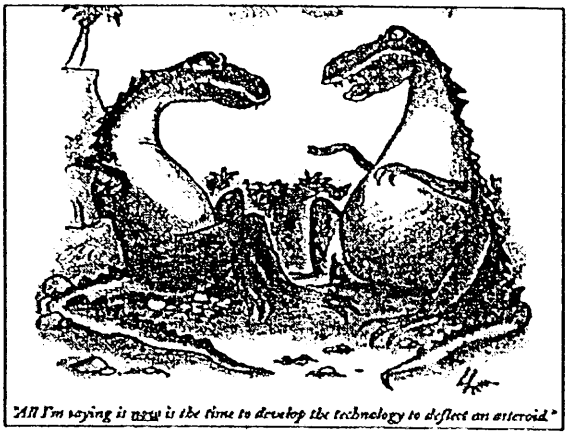
Lance E. Rodewald, M.D.

Immunization Services Division
Centers for Disease Control and Prevention

CDC

OR
How I Learned to Stop Worrying and Love Evidence-Based Public Health

CDC



"All I'm saying is now is the time to develop the technology to deflect an asteroid."

Recommended Childhood Immunization Schedule United States, January-December 2000

Age ▷ Vaccine ▽	Birth	1 mo	2 mos	4 mos	6 mos	12 mos	15 mos	18 mos	24 mos	4-6 yrs	11-12 yrs	14-16 yrs
Hepatitis B[1]												
Diphtheria, Tetanus, Pertussis[2]			DTaP	DTaP	DTaP					DTaP		
H. influenzae type b[3]			Hib	Hib	Hib							
Polio[4]			IPV	IPV						IPV[4]		
Measles, Mumps, Rubella[5]										MMR[5]		
Varicella[6]												

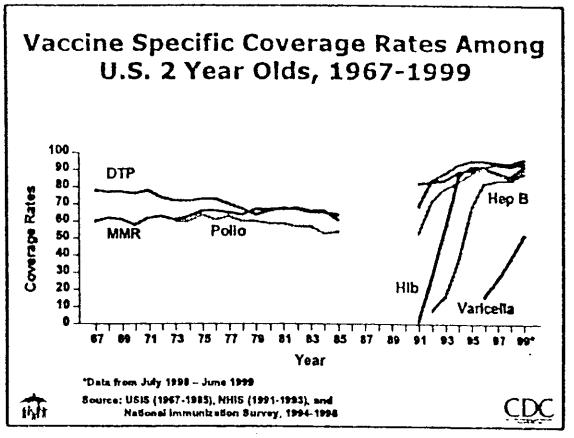
Approved by the Advisory Committee on Immunization Practices (ACIP), the American Academy of Pediatrics (AAP), and the American Academy of Family Physicians (AAFP).

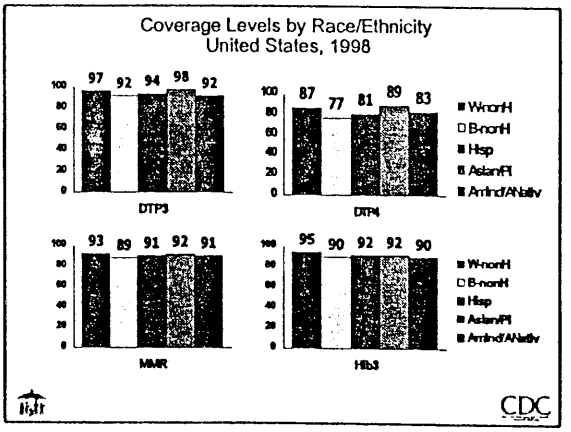
CDC

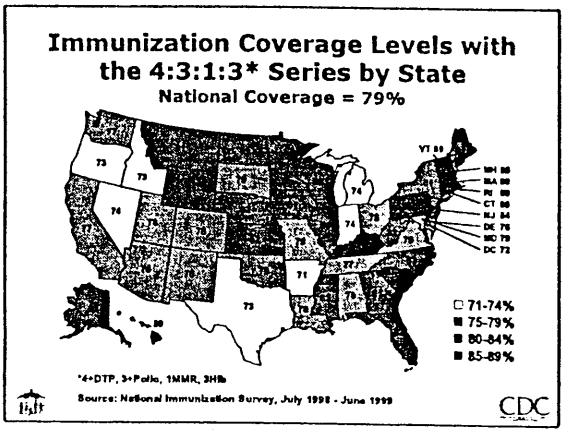
Comparison of 20th Century Annual Morbidity and Current Morbidity, Vaccine-Preventable Diseases

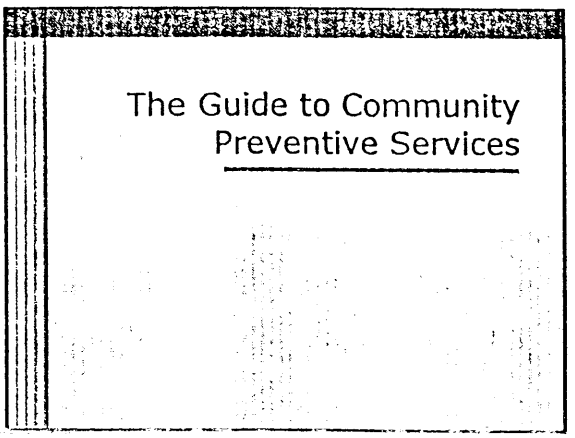
	20th Century Annual Morbidity	1999 Provisional	Percent Decrease
Diphtheria	175,885	1	100
Measles	503,282	86	100
Mumps	152,209	352	99.8
Pertussis	147,271	6,031	95.9
Polio (paralytic)	16,316	0	100
Rubella	47,745	238	99.5
Congenital Rubella Syndrome	823	8	99.0
Tetanus	1,314	33	97.5
H. *influenzae*, type b and unknown (<5 yrs)	20,000	163	99.2

CDC


Vaccine Specific Coverage Rates Among U.S. 2 Year Olds, 1967-1999
Coverage Rates
DTP
MMR
Polio
Hep B
Hib
Varicella
Year
*Data from July 1998 – June 1999
Source: USIS (1967-1985), NHIS (1991-1993), and National Immunization Survey, 1994-1998
CDC


Coverage Levels by Race/Ethnicity
United States, 1998
97 92 94 98 92
DTP3
87 77 81 89 83
DTP4
93 89 91 92 91
MMR
95 90 92 92 90
Hib3
W-nonH
B-nonH
Hisp
AsianPI
AmInd/ANativ
CDC


Immunization Coverage Levels with the 4:3:1:3* Series by State
National Coverage = 79%
71-74%
75-79%
80-84%
85-89%
*4+DTP, 3+Polio, 1MMR, 3Hib
Source: National Immunization Survey, July 1998 - June 1999
CDC



The Guide and Task Force

- Analog to *Guide to Clinical Preventive Services*
- Created by 15-member Task Force
- Has broad scope of work – e.g.:
  - Reducing motor vehicle injuries
  - Reducing vaccine preventable diseases

CDC

Tasks for the *Guide*

- Summarize what is known about effectiveness of population-based interventions for prevention and control
- Summarize available information on cost-effectiveness of interventions
- Provide evidence-based recommendations on population-based interventions and methods for their delivery
- Identify a prevention research agenda

CDC

Intended Audience for *Guide*

People involved in planning funding, and implementing population-based services and policies to improve health at the community and state level

CDC

Rationale for VPD Chapter

- Much information available on vaccine efficacy and use
- Evidence on which to base and defend programmatic strategies for improving delivery of vaccines less available or accessible
- Chapter will distill the latter

CDC

Scope of VPD Chapter

- Improving vaccination coverage
- Extending current success
  - New vaccines
  - Different populations
- Non-universal vaccination excluded

CDC

VPD Chapter Development

- Systematic review of the evidence
  - Interventions (18 selected)
  - Rules of evidence
  - Identification of studies (197 located)
- Translation into recommendations
  - Quality of study design and execution
  - Translation rules

CDC

Inclusion Criteria

- Published 1980-1997
- Universally recommended childhood, adolescent, or adult vaccines
- Primary studies
- From industrialized countries
- Written in English
- Relevant to interventions under study
- Compared exposed and unexposed

CDC

Search Results - 18 interventions

- ~4,000 titles and abstracts screened
- 197 papers eventually included in the review

CDC

Evaluating Effectiveness

- 2 reviewers read each paper and summarized information on
  - study design and execution
  - population and setting
  - intervention
  - outcome
  - results
- Discrepancies resolved by consensus

CDC

Suitability of Study Design - 1

- Greatest
  - concurrent comparison groups
  - prospective measurement of exposure and outcome
- Moderate
  - retrospective designs
  - multiple pre/post measurements but no concurrent comparison group

CDC

Suitability of Study Design - 2

- Least
  - single pre and post measurements and no concurrent comparison group
  - exposure and outcome measured in a single group at one point in time

CDC

Study Execution Criteria

- definition and selection of populations
- definition and measurement of exposure/intervention
- assessment of outcomes
- follow-up/completion rates
- bias
- data analysis
- confounding

CDC

Study Execution Rating

- Rating based on number of limitations
  - Good: 0-1 limitations
  - Fair: 2-4 limitations
  - Limited: ≥ 5 limitations

CDC

Rating a Body of Evidence - 1

- Evidence categorized as - Strong, Sufficient, or Insufficient - based on
  - numbers of studies
  - design and execution
  - consistency of findings
  - effect sizes

CDC

Rating a Body of Evidence - 2

- Primarily used studies with greatest or moderate design suitability
- Studies with least design suitability used when necessary
- Only used studies with good or fair execution
- Studies with limited execution never used

CDC

Other Issues Considered

- Generalizability
- Harms
- Cost-effectiveness
- Barriers to use
- Expert opinion (not used in this chapter)

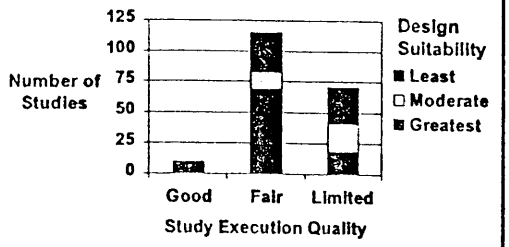
CDC

Methodologic Challenges

- Deciding on standards of evidence
- Finding all relevant evidence
- Defining and categorizing interventions, especially multi-component interventions
- Summarizing effects across studies and across outcomes
- Summarizing and presenting information on cost-effectiveness

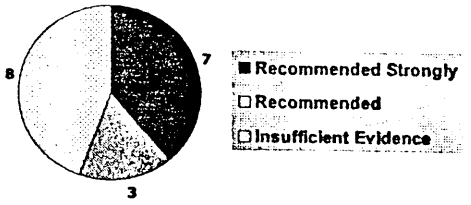
CDC

Quality of Evidence: 197 Studies



CDC

Distribution of 18 Intervention Recommendations



CDC

Recommended Strongly

- Reducing out-of-pocket costs
- Assessment with feedback to providers
- Patient recall / reminder
- Provider prompting
- Standing orders for adults
- Expanding access in health-care settings coupled with other strategies
- Education coupled with other strategies

CDC

Recommended

- WIC linkages
- School, etc., Immunization requirements
- Home visiting to promote immunizations

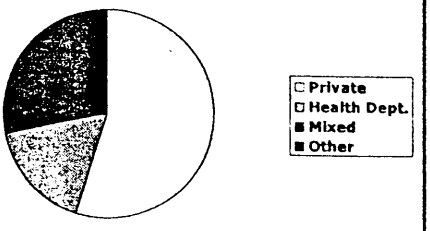
CDC

Using the *Guide*

- Identify intervention target
- Diagnose problems
- Select intervention

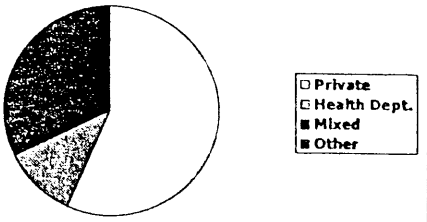
CDC

Provider Type Distribution: U.S. 1998, NIS



CDC

Provider Type Distribution: California 1998, NIS



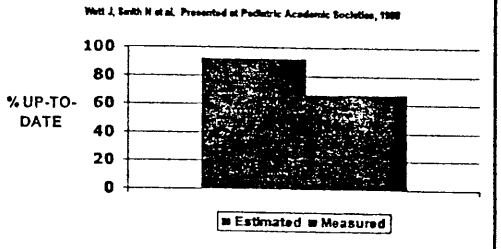
CDC

Diagnose Problems

- What are intervenable barriers?
  - Parents do not know child's vaccination status
  - Clinicians believe coverage is higher than it is
  - Records are scattered across providers
  - Clinicians do not operate recall systems
  - Clinicians miss opportunities to vaccinate
- Result is an *information gap*

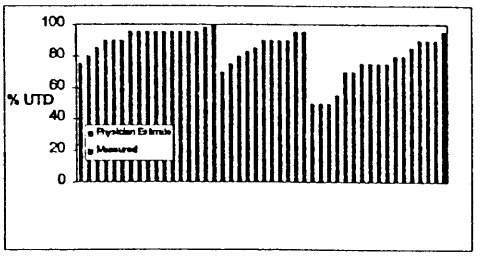
CDC

Physician-Estimated vs Measured Performance of 45 Practices



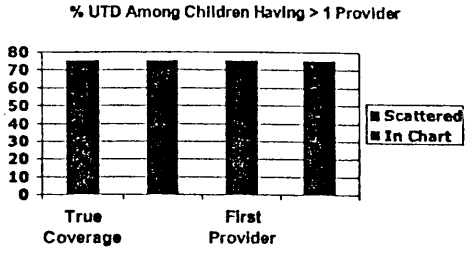
CDC

Physician-Estimated vs Measured Performance of 45 Practices



CDC

Record Scattering Impact, NHIS 1996: 4:3:1:3 Series



Stokley et al. 1999 Pediatric Academic Societies, San Francisco

CDC

Information Gap Interventions

- Community level
  - School laws
  - WIC linkages
- Provider level
  - AFIX
  - Recall and reminder
  - Prompting
- Infrastructure – registries

CDC

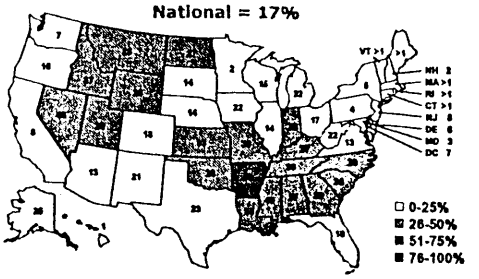
How Can We Access Providers?

- Who is in our Program?
- What is the reach of our Program?
  - Health department: 20% of children
  - VFC: >75% of children
- Intervention target: VFC providers
  - Size 43,000

CDC

Percent of Children Receiving at Least One Vaccine From a Public Health Department Clinic

National = 17%

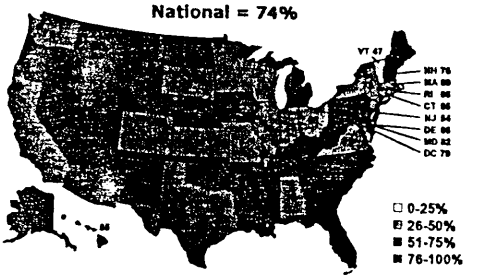


Source: National Immunization Survey, July 1996 - June 1998

CDC

Percent of Children Receiving at Least One Vaccine From a VFC Provider

National = 74%



Source: National Immunization Survey, July 1996 - June 1998

CDC

What Do We *Really* Want to Happen?

- Population-based primary care
  - Public health accountable for population
  - Clinical medicine practiced one patient at a time
  - Providers need to see their practice as a defined population
- Medical home is part of a community

CDC

Medical Home for Primary Care

- Comprehensive, continuous care
- Why a medical home?
  - Reduce scattered care
  - Reduce redundant system capacity
  - Parents prefer one-stop service
  - Failure to get vaccinated is associated with failure to receive other clinical preventive services

CDC

Problems with medical homes

- Accountability for patients
- Immunization overwhelmed by other activities

CDC

What Do We *Really* Want to See Implemented?

- Recall system (strongly recommended)
  - Forces determination of immunization status
  - Reinforces link of accountability
  - Encourages use of a medical home
  - Reconciles scattered records
  - Proven effective
  - Solves the information gap!

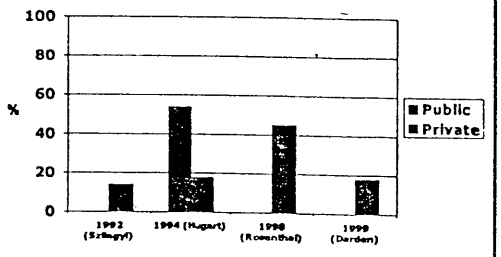
CDC

Provider Reminder/Recall

- Inform providers that individual clients are due (reminder) or overdue (recall) for vaccinations
- 60 studies reviewed
- 29 with greatest/moderate design suitability and good/fair execution
  - median coverage improvement 17%
  - range 1% => 67%

CDC

Percent of Providers With Recall Systems



CDC

Impediments

- No perceived need
  - Providers overestimate coverage of their patients
- Insufficient promotion among private providers

CDC

Strategy to Implement Recall Systems: Use Data

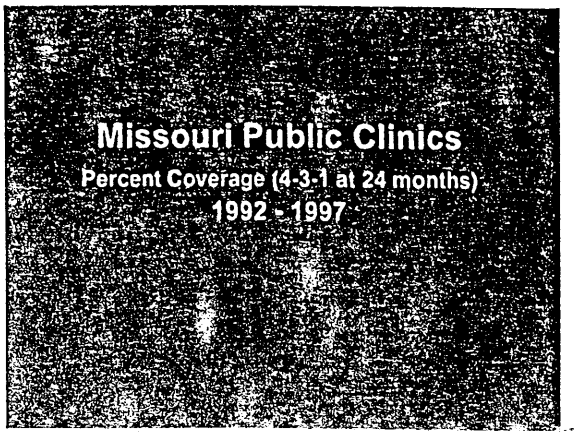
- AFIX
  - Assessment
  - Feedback
  - Incentive
  - eXchange of Information
- Several states are successful already

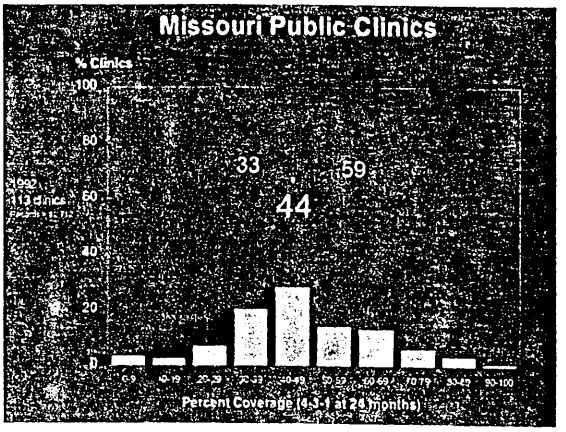
CDC

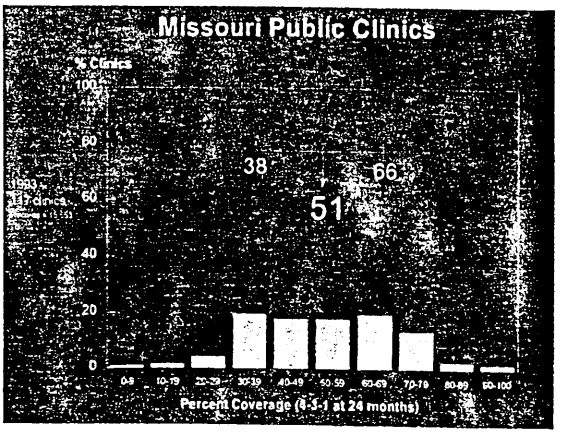
Feedback to Providers

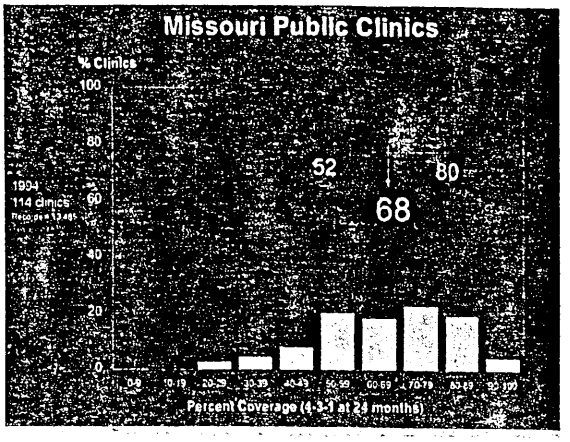
- Inform providers of their performance
- 27 studies reviewed
- 14 with good/fair execution
  - median coverage improvement 16%
  - range 1% => 43%

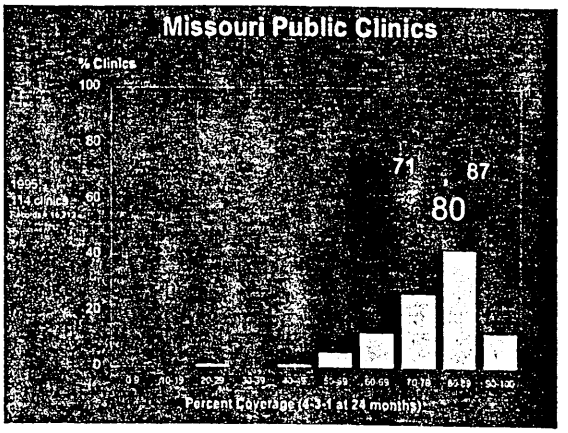
CDC

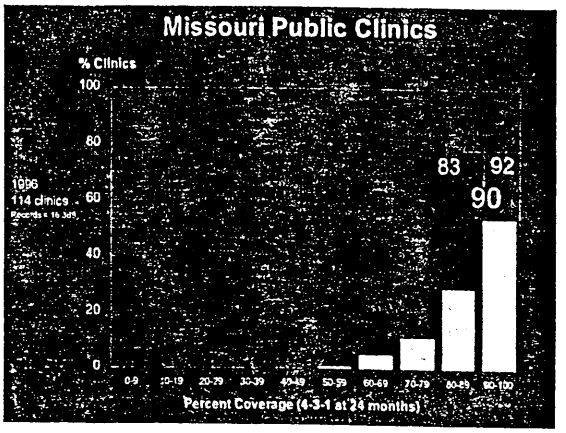

Missouri Public Clinics
Percent Coverage (4-3-1 at 24 months)
1992 - 1997

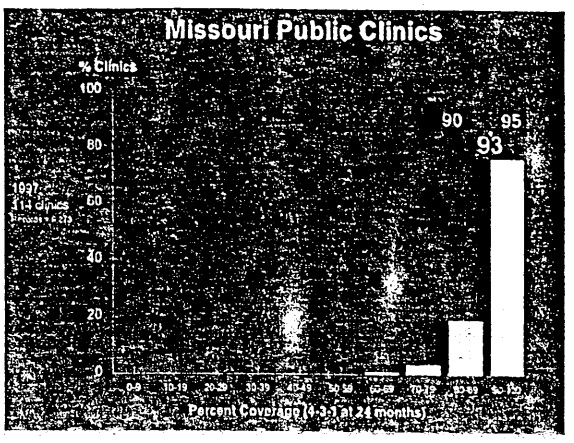

Missouri Public Clinics
% Clinics
100
80
60
40
20
0
33
59
44
1992
113 clinics
Percent Coverage (4-3-1 at 24 months)


Missouri Public Clinics
% Clinics
100
80
60
40
20
0
38
66
51
Percent Coverage (4-3-1 at 24 months)


Missouri Public Clinics
% Clinics
100
80
60
40
20
0
52
80
68
1994
114 clinics
Percent Coverage (4-3-1 at 24 months)


Missouri Public Clinics
% Clinics
100
80
60
40
20
0
71
87
80
Percent Coverage (4-3-1 at 24 months)


Missouri Public Clinics
% Clinics
100
80
60
40
20
0
83
92
90
1996
114 clinics
Percent Coverage (4-3-1 at 24 months)

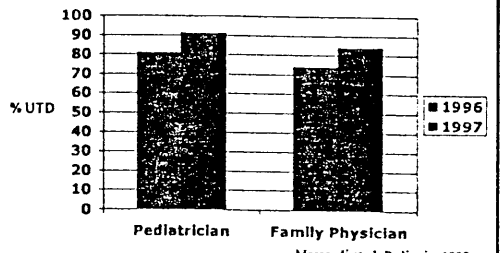


Private Provider Assessments: Maine

- State characteristics
  - Universal purchase
  - 90% private sector delivery
  - 300 providers
- Assessments
  - Collaboration: AAP and Immunization program
  - All private practices assessed once
  - Largest assessed twice
- High performing practices recognized

CDC

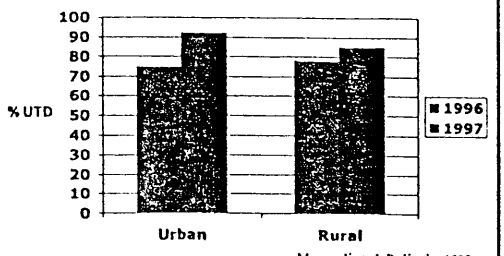
Improvement by Specialty



Massoodi et al. Pediatrics 1999

CDC

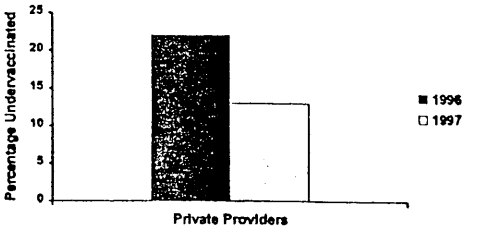
Improvement by Geography



Massoudi et al. Pediatrics 1999

CDC

Impact of AFIX Among Private Providers, Maine, 1996-1997



Source: Massoudi et al. Pediatrics 1999

CDC

Maine Experience

- Characteristics of program
  - Collaborative
  - Minimally intrusive
  - Spirit of improvement
- Demonstration of feasibility

CDC

Summary, National Level

- Target
  - VFC providers
- Diagnosis
  - Information gap
- Selected interventions
  - VFC provider AFIX
  - Recall systems

CDC

Immunization Purchasing Specifications

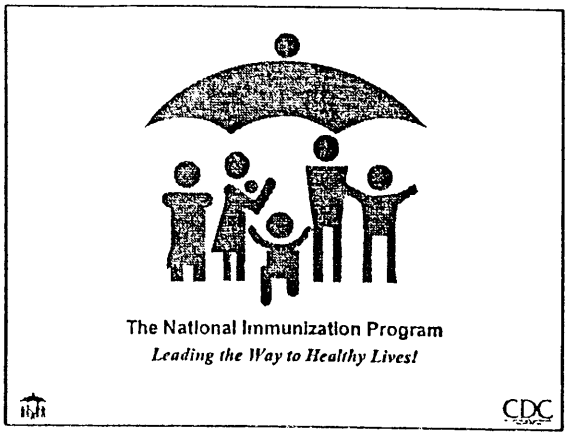
- New York: "The state requires individual network physicians...to participate in the VFC program."
- New Jersey: "The contractor must provide EPSDT equivalent services...which include...appropriate immunizations according to...the ACIP."
- Oklahoma: "The contractor agrees to use the Oklahoma State Department of Health Statewide Immunization Information System database...."
- California: "The contractor will ensure reimbursement to LHDs for the administration fee of immunizations given to members."

CDC

Opportunity

- The *Guide*
  - Expanded our knowledge base
- The VFC program
  - Expanded our reach
- The combination
  - Is an environment for *evidence-based public health*

CDC



Challenges

- No reminders
- Missed opportunities
- Complex schedule
- Scattered records
- Coverage overestimates
- Scarce resources

CDC

Challenges	Registry Solutions
No reminders	→ Automatic reminders
Missed opportunities	→ Complete and accurate records
Complex schedule	→ Decision-support
Scattered records	→ Aggregated records
Coverage overestimates	→ Coverage assessments
Scarce resources	→ Targeted efforts

CDC

Reviews of Evidence Regarding Interventions to Improve Vaccination Coverage in Children, Adolescents, and Adults

Peter A. Briss, MD, Lance E. Rodewald, MD, Alan R. Hinman, MD, MPH, Abigail M. Shefer, MD, Raymond A. Strikas, MD, Roger R. Bernier, PhD, Vilma G. Carande-Kulis, MS, PhD, Hussain R. Yusuf, MBBS, MPH, Serigne M. Ndiaye, PhD, Sheree M. Williams, PhD, The Task Force on Community Preventive Services

Background: This paper presents the results of systematic reviews of the effectiveness, applicability, other effects, economic impact, and barriers to use of selected population-based interventions intended to improve vaccination coverage. The related systematic reviews are linked by a common conceptual approach. These reviews form the basis for recommendations by the Task Force on Community Preventive Services (the Task Force) regarding the use of these selected interventions. The Task Force recommendations are presented on pp. 92–96 of this issue.

Medical Subject Headings (MeSH): vaccine-preventable diseases, vaccination coverage, community health services, decision-making, evidence-based medicine, systematic reviews, population-based interventions, practice guidelines, preventive health services, public health practice, task force. (Am J Prev Med 2000;18(1S):97–140) © 2000 American Journal of Preventive Medicine

Introduction

Vaccine-preventable diseases among children, adolescents, and adults represent major continuing causes of morbidity and mortality in the United States. During the latter half of the twentieth century, the success of childhood vaccination programs in the United States has led to a >95 % decline in most vaccine-preventable diseases of childhood. However, >400,000 cases of illness and >30,000 deaths caused by vaccine-preventable diseases still occur each year[1] (CDC unpublished data).

Diphtheria, invasive *Haemophilus influenzae* type b (Hib) disease, measles, poliomyelitis, rubella, tetanus, mumps, varicella, and pertussis are typically referred to as vaccine-preventable diseases of childhood. Vaccinations primarily indicated for adults include influenza, pneumococcal, and hepatitis B. However, during the 1990s, the distinction between childhood and adult vaccine-preventable diseases became less clear. Many childhood vaccine-preventable infections, including measles and pertussis, are found increasingly among adults,[2,3] and hepatitis B vaccinations are now routinely recommended for infants and adolescents. Table 1 outlines universally recommended (i.e., vaccinations recommended for most or all persons in certain age groups) vaccinations for children, adolescents, and older adults.

In children, >50,000 cases of varicella occur each year, making that disease the most common vaccine-preventable disease among children[4]; in adults, influenza, pneumococcal disease, and hepatitis B are all still common vaccine-preventable diseases, with hundreds of thousands of cases occurring each year.[5] Mortality attributable to vaccine-preventable diseases is still substantial. Each year, approximately 500 persons in the United States die of childhood vaccine-preventable diseases, and >30,000 adults die of influenza, pneumococcal infections, and hepatitis B.[1] Influenza, which accounts for an average of 20,000 deaths/year, is usually the largest killer.[5]

The effectiveness of universally recommended vaccinations in preventing disease for adults, adolescents,

From the Division of Prevention Research and Analytic Methods, Epidemiology Program Office, Centers for Disease Control and Prevention (Briss, Carande-Kulis), Atlanta, Georgia, National Immunization Program, Centers for Disease Control and Prevention (Rodewald, Shefer, Strikas, Bernier, Yusuf, Ndiaye), Atlanta, Georgia, Task Force for Child Survival and Development (Hinman), Atlanta, Georgia, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention (Williams), Atlanta, Georgia

The names and affiliations of the Task Force members are listed on page v of this supplement and at http://www.thecommunityguide.org

Address correspondence and reprint requests to: Peter A. Briss, MD, Senior Scientist, Community Preventive Services Guide Development Activity, Epidemiology Program Office, MS K73, Centers for Disease Control and Prevention, 4770 Buford Highway, Atlanta, GA 3034. E-mail: pxb5@cdc.gov.

Some of this material was published previously in: Shefer A, Briss P, Rodewald L, et al. Improving immunization coverage rates: an evidence-based review of the literature. Epidemiol Rev 1999;20:96–142.

0749-3797/00/$–see front matter
PII S0749-3797(99)00118-X

Table 1. Universally recommended vaccinations

Population	Vaccination	Dosage
All young children	Measles, mumps, and rubella	2 doses
	Diphtheria-tetanus toxoid and pertussis vaccine	5 doses
	Poliomyelitis	4 doses
	Haemophilius influenzae type B	3–4 doses
	Hepatitis B	3 doses
	Varicella	1 dose
Previously unvaccinated or partially vaccinated adolescents	Hepatitis B	3 doses total
	Varicella	If no previous history of varicella, 1 dose for children aged <12 years,2 doses for children aged ≥13 years
	Mumps, measles, and rubella	2 doses, total
	Tetanus-diphtheria toxoid	If not vaccinated during previous 5 years, 1 combined booster during ages 11–16 years
All adults	Tetanus-diphtheria toxoid	1 dose administered every 10 years
All adults aged ≥65	Influenza	1 dose administered annually
	Pneumococcal	1 dose

and children is well-established.[6–14] In addition to protecting individuals from diseases passed from person to person contact, vaccination provides population-based (herd) immunity that prevents circulation of infectious agents. In general, uniformly high coverage levels will maximize protection of individuals and the population.

Vaccination coverage levels among U.S. school children exceeds 98% for vaccination with diphtheria-tetanus toxoids and pertussis vaccine (DTP)/pediatric formulation of diphtheria and tetanus toxoids (DT), oral poliovirus vaccine (OPV), measles-containing vaccine, and Hib.[15] Vaccination coverage among U.S. children aged 19–35 months exceeds 90% for 3 or more doses of DTP/DT, 3 or more doses of OPV, 1 or more doses of a measles-containing vaccine, and 3 or more doses of Hib vaccine,[16] but is lower for 4 or more doses of DTP vaccine (81%), 3 or more doses of hepatitis B vaccine (84%), and 1 dose varicella vaccine (26%). In addition, certain populations remain at higher risk for underimmunization. Recent data indicate that coverage levels for children aged 2 years remain significantly lower among urban populations as well as among low-income populations.[16,17]

Vaccinations recommended for adults and more recently for adolescents are underused. Recent estimates indicate that <60%[18] of adults aged >65 years are vaccinated against influenza and pneumococcal infection. No reliable estimates exist for vaccination coverage levels among adolescents.

Conceptual Approach

An explanation of the methods used to conduct the systematic reviews and arrive at the evidence-based recommendations contained in this paper is found in Appendix A. Tables and figures summarizing effectiveness findings and tables that support our economic analyses are available at the website: http://web.health.gov/communityguide.

An illustration of our logic framework depicts the conceptual approach that we chose during the review process (Figure 1). This figure portrays the relationships between a population, environmental and health system determinants, categories of interventions, and outcomes. By displaying our conceptual approach graphically, we are able to: (1) indicate intervention options for changing relevant outcomes; (2) indicate categories of related interventions; (3) describe the outcomes that the interventions attempt to influence; and (4) indicate the types of interventions that are included in these reviews and those that are not.

We focused on interventions intended to improve routine delivery of universally recommended vaccinations. We chose not to address vaccinations with more targeted indications, e.g., persons with specific medical conditions such as asthma or people who were at higher than usual risk of exposure to vaccine-preventable diseases such as travelers. The major outcomes considered included attendance in health care systems, delivery of vaccinations, and vaccine-preventable disease occurrence.

Three categories of interventions were selected: (1) increasing community demand for vaccination, (2) enhancing access to vaccination services, and (3) provider-based interventions.

The selected interventions within those categories were characterized by: (1) the nature of the activities involved; (2) the manner of delivery of the activities; (3) the type of people targeted, e.g., general population, groups at high risk, or a particular professional group; and (4) the setting in which the intervention was

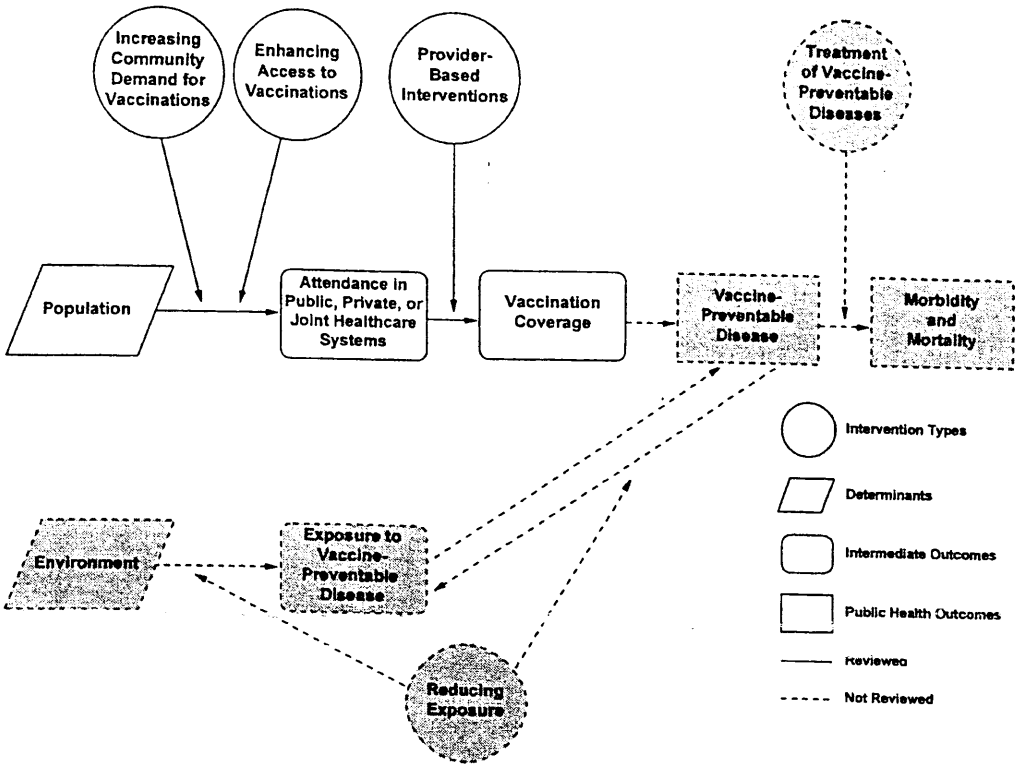


Figure 1. Logic framework depicting the conceptual approach used in these reviews.

applied, e.g., health care setting, nonhealth care setting, or community-wide setting. We reviewed interventions that were either single-component—using only one activity, or multicomponent—using more than one activity together, to achieve desired outcomes. We assessed the effectiveness of multicomponent interventions in improving coverage and changing other outcomes whether or not the relative contribution of individual components could be ascribed. We did not address strategies that reduce exposures to vaccine-preventable diseases, e.g., quarantine or outbreak control, nor did we evaluate the effectiveness of treatment of vaccine-preventable disease to reduce morbidity and mortality.

We grouped similar interventions together on the basis of their similarity and depth of available literature, i.e., the more literature available, the more subcategories that could be evaluated. Sometimes, we found that our classification or nomenclature was different from that used in the original studies being reviewed. When such a discrepancy occurred, we grouped interventions according to our definitions. By the end of the review process, we had reviewed the evidence of effectiveness of 17 interventions that we felt were likely to have a significant impact or were widely practiced. Time and resource constraints prohibited our evaluating other major categories of interventions.

Some activities that might improve vaccination coverage were not considered to be interventions for the purposes of these reviews. Activities that provide information for public health action (e.g., vaccination registries) provide useful information and might even incorporate or lead to interventions (e.g., client reminder/recall interventions, provider reminder/recall interventions, and assessment and feedback for vaccination providers). However, we considered registries to represent a part of the public health infrastructure rather than being interventions themselves. Similarly, improving vaccines (e.g., developing vaccines that are less likely to cause adverse reactions or increasing numbers of antigens contained in a vaccine, thus reducing the number of injections required) can lead to better vaccination coverage. However, improving vaccines is primarily done for other reasons (e.g., harm reduction or to allow the administration of more antigens than would otherwise be feasible) and is therefore not considered to be an intervention for the purposes of these reviews.

Healthy People 2010 Goals and Objectives for Improving Vaccination Coverage

The interventions reviewed in this paper could be useful for reaching many of the objectives in *Healthy People 2000*[19] and *Healthy People 2010*[a]; those objectives are the prevention agenda for the United States. They identify the significant preventable threats to health

[a]US Health and Human Services, Draft for Public Comment, September 1998.

Table 2. 2010 Objectives related to vaccination and vaccine-preventable diseases

22.1	Reduce indigenous cases of vaccine-preventable disease
22.2	Monitor the national impact of influenza vaccinations on influenza-related hospitalizations and mortality among high-risk populations by annually collecting, analyzing, and reporting data from at least one medical care organization in all nine influenza surveillance regions of the country
22.5	Reduce to zero cases per 100,000 hepatitis B rates in persons aged <25 (except perinatal infections)
22.17a	Decrease the incidence of invasive pneumococcal infections to 49 per 100,000 persons aged <5 years
22.17b	Decrease the incidence of invasive penicillin-reistant pneumococcal infections to 6.2 per 100,000 population aged ≥65 years
22.21	Achieve immunization coverage of at least 90% among children aged 19–35 months
22.22	Ensure that all 50 states achieve immunization coverage of at least 90% among children aged 19–35 months for [selected antigens]
22.23	Maintain immunization coverage at 95% for children in licensed day care facilities and children in kindergarten through the first grade
22.24	Increase to 90% the rate of [influenza and pneumococcal] immunization coverage among adults aged ≥65; 65% for high-risk adults aged 18–64 years
22.30	Increase to 90% the number of 2-year-old children who receive vaccinations as part of comprehensive primary care
22.31	(Develomental) increase to XX% the number of immunization providers who have systematically measured the immunization coverage levels in their practice population
22.32	(Developmental) increase to XX% the number of children enrolled in a fully functional population-based immunization registry (birth through age 5)

XX, percentages not specified

and focus public and private sector efforts for addressing those threats. Many of the proposed Healthy People objectives in Chapter 22, "Immunization and Infectious Diseases," relate to vaccination and vaccine-preventable disease. This paper provides information on tested interventions that could help communities and health care systems reach Healthy People objectives. Healthy People objectives are shown in Table 2.

Information from Other Advisory Groups

Information Regarding Use of Vaccines

The *Guide to Clinical Preventive Services* documents the effectiveness of vaccination in preventing disease among individuals and provides general recommendations for clinical practice regarding vaccinations.[14] Recommendations regarding administration of childhood vaccinations are issued regularly by the Advisory Committee on Immunization Practices (ACIP) of the U.S. Department of Health and Human Services/Centers for Disease Control and Prevention,[11] the American Academy of Pediatrics (AAP),[7] and the American Academy of Family Physicians (AAFP).[6] Since 1995, the AAP, AAFP, and ACIP have collaborated regarding a harmonized childhood vaccination schedule.[11] Recommendations regarding the administration of adolescent and adult vaccinations are published by ACIP,[12,13] the American College of Physicians,[9] Infectious Disease Society of America,[9,20] AAFP,[6] and the American College of Obstetricians and Gynecologists.[8] Vaccination recommendations for adolescents are now coordinated among ACIP, AAP, AAFP, and the American Medical Association.

Information Regarding Improving Vaccination Coverage

Summaries and recommendations regarding interventions to improve vaccination coverage have been developed by the Canadian Community Health Practice Guidelines Working Group,[21,22] ACIP,[23,24] and the National Vaccine Advisory Committee.[25]

Interventions: Increasing Community Demand for Vaccinations

Interventions that increase community demand for vaccinations are designed to increase knowledge regarding and demand for vaccination services. Interventions that increase community demand for vaccinations reviewed in this report include client reminder/recall, multicomponent interventions that include education, vaccination requirements for child care, school, and college attendance, community-wide education only, client or family incentives, and client-held medical records.

Client Reminder/Recall

Background. Reminders and recalls allow clients to know when vaccinations are due or overdue, as well as when to contact their vaccination provider to determine if vaccinations are needed. Reminders or recalls can be mailed or communicated by telephone; an autodialer can be used to expedite telephone reminders. Client reminders can be either specific (i.e, certain vaccinations are due on a specific date) or general.

Review of evidence: effectiveness. Our search identified 60 studies regarding the effectiveness of client reminder/recall interventions.[26–85] Nine additional papers provided more information regarding an already included study.[86–94] A total of 18 studies had limited execution[26,27,34,51,54,56,60,62,69,70,75,81,85] or least suitable designs [35,44,53,58,73] and were therefore not included in

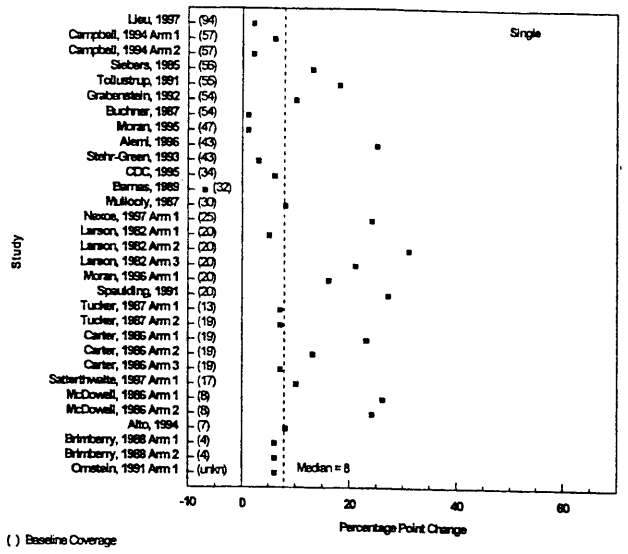


Figure 2. Percentage point change in vaccination coverage attributable to single component client reminder/recall interventions from studies that qualified for inclusion in this review.

the review. Details of the 42 qualifying studies are provided in Figures 2 and 3, Appendix B, and at the website: http://web.health.gov/communityguide.

The qualifying studies reported on 34 intervention arms that evaluated reminders or recalls used alone and 25 intervention arms evaluating multicomponent interventions that included reminders or recalls. Multicomponent interventions also included expanded access,[31–33,36,37,57,63,66,72,84] provider reminders,[36,38,42,43,52,72,74] clinic-based education,[28,29,31,33,36,42] provider education,[30–33,36,63] reducing out-of-pocket costs,[28,30,32,66,71,76] provider assessment and feedback,[36,42,47] client incentives,[33,66,84] community-wide education,[30,32,38] standing orders,[63,72] the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) program interventions,[32] home visits,[33] and client-held medical records.[28]

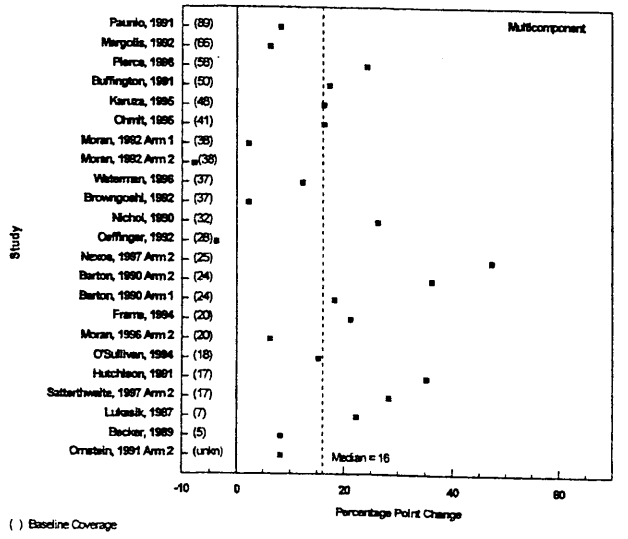


Figure 3. Percentage point change in vaccination coverage attributable to multiple component interventions including client reminder/recall from studies that qualified for inclusion in this review.

Two qualifying studies[78,84] provided data that could not be expressed as a percentage point change in coverage. The remaining studies provided data regarding 31 single-component and 23 multicomponent intervention arms. Overall, these studies documented a median percentage point change of 12% (range, −8%–47%). Studies that evaluated client reminder/recall-only interventions documented a median percentage point change of 8% (range, −7%–31%). Studies that evaluated client reminder/recall as part of a multicomponent intervention documented a median percentage point change of 16% (range, −8%–47%).

Most qualifying studies evaluated reminders, although some evaluated both reminders and recalls[39] or recalls only.[61,82] Studies evaluated both telephone[39,40,45,52,54,60] and mailed[29,40,41,45–50,55,57,61,64–68,71,76–78,82–84] reminders. Mailed reminders included both letters and postcards. Two studies[45,64] directly compared mailed reminders with telephone reminders and did not find a difference regarding effectiveness between them. Six studies evaluated intensity of reminders (e.g., general to more specific, generic to personalized, and signed by physician as well as greater versus lesser numbers of reminders),[49,50,59,66,83,84] and five of the six studies found greater increases in coverage with more-intensive reminders. No studies were found evaluating reminders delivered by computers (e.g., by e-mail).

Review of evidence: applicability. The same body of evidence used to assess effectiveness was used to assess the applicability of these interventions to different settings, populations, and vaccinations. Studies have included adults[30,36,37,41–43,45–47,49,52,55,57,59,63–68,71,72,74,76,77,83] and children.[29,31–33,38–40,48,61,78,80,82,84] Adolescents have been studied in mother-infant pairs[28] but have not been studied regarding their own vaccinations. Studies have included white,[31,55,84] black,[28,29,39,41,43,48,74] and Hispanic[29,31,32,40] persons, urban,[28,36,39,41,45,48,49,57,67] suburban,[41,45,46] and rural[45,46,50,52] populations, and both poor[28,31–33,39,40,43,46,48,52,65,74] and nonpoor[31,46,55,61] persons. Studies have been done in a range of settings including academic clinical settings,[28,29,40,43,45,48,59,64,66,77] public health settings,[31,80,82,83] managed care,[33,61,63,68] private practice,[36,46,47,52] pharmacies,[55] and community-wide settings.[30,38,50,78] Studies are available to assess the effectiveness of these interventions to improve vaccination delivery of measles, mumps, and rubella (MMR),[32,33,38–40,61] DTP,[29,31–33,39,40,48,80,82] OPV,[29,31–33,39,40] Hib,[33,39,40] influenza,[30,36,37,41–43,45–47,49,50,55,57,59,63–68,71,72,76,79,83] pneumococcal,[43,77] and adult formulation of diphtheria and tetanus toxoids (Td).[43,52,64] No studies were found

evaluating client reminder/recall to encourage adolescent vaccinations or to improve delivery of hepatitis B vaccinations.

Review of evidence: other positive or negative effects. No other positive or negative effects of client reminder/recall interventions were sought in this review.

Review of evidence: economic. Our search identified 11 economic evaluations of client reminder/recall interventions.[27,46,52,61,65,71,93,95–98] One additional paper provided more information regarding an already included study.[64] Details of the studies are provided in Appendix C and at the website: http/web.health.gov/communityguide. A total of 9 studies provided 12 cost-effectiveness ratios for single-component reminder/recall interventions and 3 cost-effectiveness ratios for multicomponent interventions that include reminder/recall. Adjusted cost-effectiveness ratios for single-component interventions based on those studies ranged from $3 per additional vaccination to $46 per additional vaccination (median, $9). Adjusted cost-effectiveness ratios for multicomponent interventions were $4 per additional vaccination for a combination of client and provider reminders[52]; $51 per additional vaccination for a combination of reminders and a lottery-type incentive[65]; and $43 per additional vaccination for a combination of mailed reminders and free vaccinations.[71]

Adjusted average costs based on 2 available studies varied from $0.65 to $5.75 per child. The lower cost is an underestimate because the cost of the in-kind contribution of volunteer time was not included. The upper cost might be an overestimate because it includes costs of clinical time to provide vaccinations.

Barriers to intervention implementation. Barriers to implementing reminder/recall interventions might include lack of information infrastructure and administrative burden on providers or systems.

Conclusion. According to the *Guide*'s rules of evidence, strong scientific evidence exists that client reminder/recall is effective in improving vaccination coverage.

Multicomponent Interventions That Include Education

Definition. Multicomponent interventions that include education provide knowledge to target populations and sometimes, to vaccination providers, and use at least one other activity to improve vaccination coverage.

Background. Multicomponent interventions that include education address health concerns and barriers to vaccination in an integrated way. Multicomponent interventions that include education are based on the premise that prerequisites to health include the physical, social, and political environment in which health risks occur. These interventions make community members aware of vaccination services available to them, the utility and relevance of these services, and information that will help to take advantage of these services. These interventions also incorporate a variety of associated strategies to improve vaccination.

Review of evidence: effectiveness. Our search identified 34 studies regarding the effectiveness of multicomponent interventions that include education.[26–38,99–120] Three additional papers provided more information regarding an already included study.[86,87,89] Seventeen studies had limited execution and were therefore not included in the review.[26,27,34,99–105,109,110,112,113,115,116,119] Details of the 17 qualifying studies are provided at the website: http://web.health.gov/communityguide. All qualifying studies evaluated interventions that included community or client education. The interventions also included client reminders,[28–33,35,36,38] provider education,[30–33,36,108] expanded hours or access in clinical settings,[31–33,36,107,111] provider reminders,[28,36–38,106,114] reducing out-of-pocket costs,[28,30,32,108] client-held vaccination records,[28,117] WIC interventions,[32] medical and psychosocial assessments,[107] nutrition services,[107] and home visits.[33] Fifteen studies[28–33,35–38,106–108,117,118] that reported measures of vaccination coverage found percentage point changes in vaccination coverages ranging from −4% to 29% (median, 16%) in follow-up times of as much as 5 years. Positive effects were found both in clinical and community settings (median, 16%, range, −4%–25% versus median, 12%, range, 5%–29%, respectively). Available data do not allow attribution of the portion of the overall effect of the interventions to individual components but suggest that combined interventions increase vaccination coverages.

Any of several reasons could explain the fact that multicomponent interventions that include education seemed effective in improving vaccination coverages, whereas some components (e.g., community-wide education [section 4], clinic-based education [section 5], and expanded clinic hours or access [section 9]) by themselves demonstrate less-convincing evidence of effectiveness. Possibly, this reflects the following:

- more studies of multicomponent interventions;
- greater intensity (and thus greater effectiveness) of multicomponent interventions;
- synergy between components of multicomponent interventions (i.e., the whole is more effective than the sum of the parts); or
- education only might not cause large increases in acceptance of vaccinations, but could facilitate implementation of other components.

Review of evidence: applicability. The same body of evidence used to assess effectiveness was used to assess the applicability of these interventions to different settings, populations, and vaccinations. Studies have

included adults[30,36,37,106,108,114,117,118] and children.[28,29,31–33,35,38,107] Adolescents have been studied in mother-infant pairs[28,107] but have not been studied regarding their own vaccinations. Studies have been performed in populations including white,[31,117,108,118] black,[28,29] and Hispanic[29,31,32,107,117] persons and in populations including poor[28,31–33,114] and non-poor[31,107] persons. Studies in clinical settings come primarily from academic clinical organizations[28,29,106,107,114,117,118] but have also been done in private physician's offices,[36] public health clinics,[31] and managed care.[33] Studies are available that demonstrate improvements in vaccination delivery of influenza,[30,36,37,108,117,118] pneumococcal,[106,117,118] Td,[114,117] DTP and OPV,[29,31–33] MMR,[32,33,38,111] and Hib.[33] No studies were found evaluating multicomponent educational strategies to encourage adolescent vaccinations or to improve delivery of hepatitis B vaccinations.

Review of evidence: other positive or negative effects. Several qualifying studies that assessed nonvaccination outcomes (e.g., improved delivery of other preventive or clinical care)[28,107,114,117] found improvements in some nonvaccination outcomes. Other positive or negative effects of multicomponent educational interventions are discussed under the individual components.

Review of evidence: ecomonic. Our search identified two economic evaluations of multicomponent interventions that include education.[109,120] Details of the studies are provided at the website: http//web.health.gov/communityguide. No studies of cost-effectiveness were available. One study evaluated the costs of an intervention that included assembling a community task force, undertaking a media campaign, and implementing a school-based program that assessed students' immunization status and delivered vaccinations.[109] The adjusted estimate of average program costs based on that study is $23 per child vaccinated. Another study estimated the costs of an intervention that included expanded access to vaccination services, multiple education and health promotion activities, and possibly, provider assessment and feedback.[120] The adjusted estimate of average program costs based on that study is $7.65 per vaccination delivered. Children in the first study could have received more than one vaccination, so the estimates might be more similar than they appear.

Barriers to intervention implementation. Potential barriers to implementing multicomponent educational strategies could include difficulties in coordinating strategies between varying programs and administrative systems.

Conclusion. According to the *Guide*'s rules of evidence, strong scientific evidence exists that multicomponent interventions that include education are effective in improving vaccination coverage. However, the contribution of individual components to the overall effectiveness of these interventions cannot be attributed.

Vaccination Requirements for Child-Care, School, and College Attendance

Definition. Child care, school, and college requirements are laws or policies requiring vaccinations or other documentation of immunity as a condition of attendance.

Background. Enactment and enforcement of state immunization laws during the 1970s–1980s led to >95% of school-aged children now being appropriately vaccinated with recommended doses of vaccine. Immunization requirements for child care and college attendance and their enforcement are more recent and vary greatly among states.

Review of evidence: effectiveness. Our search identified 10 studies regarding the effectiveness of vaccination requirements for child care, school, or college attendance.[121–130] An additional paper provided more information regarding an already included study.[131] One study had limited execution and was not included in the review.[130] Details of the 9 included studies are provided at the website: http://web.health.gov/communityguide. Six of the available studies found reductions in disease rates.[121,123,125,127–129] Three nationwide cross-sectional or before/after studies found that states with immunization requirements for school-age children had lower incidence of measles[125,129] and mumps.[128] Additionally, officials in areas with low incidence of measles were more likely to enforce school laws by excluding noncompliant children from attendance.[125] A cross-sectional study from New Jersey found that children covered by a law requiring mumps vaccination were much less likely to have mumps during an outbreak than other children.[123] A time-series study from New York found that requiring Hib vaccinations for attendance in child care (without any enforcement) resulted in declines in Hib incidence among child care attendees that exceeded declines for New York as a whole.[127] A retrospective cohort study found that state laws requiring prematriculation measles vaccinations resulted in lower risk for measles outbreaks after controlling for other variables.[121]

The three studies that looked at vaccination coverage as an outcome found a median percentage point change of 15% (range, 5%–35%). A before/after study in Ontario, Canada,[122] found that immunization requirements for all school attendees aged 5 to 17 years produced coverage differences ranging from 3% to 9% by antigen (equally weighted average = 5%) from a relatively high baseline coverage of 87%. A time-series study[126] over a 7-year period (1979–1986) following enactment of school laws in California in 1977 and enforcement in 1986 documented that vaccination

coverage among children aged 5 to 6 years increased approximately 15% from a baseline coverage of approximately 75%. A cross-sectional study[123] in New Jersey found that children aged <7 years required by a school law to be vaccinated against mumps were more likely to have "documented immunity" (either vaccination or physician documented history of disease) than children not covered by the law (96% versus 61%, respectively). A time-series study[124] that evaluated the effect of a school law for rubella regarding immunity to rubella found an initial improvement in immunity that was not sustained several years later.

Review of evidence: applicability. The same body of evidence used to assess effectiveness was used to assess the applicability of these interventions to different settings, populations, and vaccinations. The majority of the available studies evaluated school laws,[122,123–126,128,129] but other studies also evaluated vaccination requirements for child care[127] and college attendance.[121] Generally, available studies did not describe the study populations in detail. However, many of these studies included all 50 states.[125,128,129] Other studies used representative samples of U.S. 2- and 4-year colleges[121]; statewide data from New York[127] or California[126]; or provincial data from Ontario, Canada.[122] The evidence of effectiveness should apply to most children and young adults in the United States.

Studies are available that assess the effectiveness of these interventions in improving delivery of MMR or other measles-containing vaccinations[122,126] and in reducing occurrence of measles[125,129] and mumps[123,128]; in improving coverage with DT or DTP and OPV[122,126]; and in reducing incidence of Hib.[127] No studies were found evaluating the effectiveness of these interventions in improving delivery of hepatitis B vaccinations.

Review of evidence: other positive or negative effects. No other positive or negative effects of vaccination requirements for child care, school, or college attendance were sought in this review.

Review of evidence: ecomonic. No economic evaluations of vaccination requirements for child care, school, and college attendance were identified.

Barriers to intervention implementation. Potential barriers to implementation of vaccination requirements for child care, school, and college attendance include administrative burden, difficulty coordinating various programs, and difficulty passing legislation.

Conclusion. According to the *Guide*'s rules of evidence, sufficient scientific evidence exists that vaccination requirements for child care, school, and college attendance are effective in improving vaccination coverage and immunity and/or in reducing rates of disease.

Community-wide Education Only

Definition. Community-wide education-only interventions provide information to most or all of a target population in a geographic area. These interventions can also provide information to vaccination providers. Interventions that have additional features (e.g., reminders), are used in combination with other interventions (e.g., multicomponent interventions that include education), or are limited to site-specific efforts in a particular setting (e.g., schools or child care centers) are reviewed elsewhere in this paper.

Background. Community-wide education is intended to improve the availability of information regarding vaccinations and increase knowledge, thereby changing behavior. Educational messages can be delivered by various methods (e.g., mail, radio, newspapers, television, and posters). Community-wide education can result in increases in vaccination coverage by increasing acceptance and demand for vaccinations among clients.

Review of evidence: effectiveness. Our search identified six studies regarding the effectiveness of community-wide education-only interventions.[38,56,75,132–134] Of these, five[56,75,132–134] had limited execution and were therefore not included in this review. The qualifying time-series study, conducted with children, found some improvements in the number of measles vaccinations delivered among those aged 6 years but not among those aged 14 to 18 months coincident with a mass-media campaign. The study did not provide substantial information regarding content or intensity of the intervention. Details of the qualifying study are provided at the website: http://web.health.gov/communityguide. No studies were identified evaluating the effect of community-wide education-only interventions regarding knowledge or attitudes.

Review of evidence: other positive or negative effects. No studies evaluating other positive or negative effects of community-wide education-only interventions were sought.

Conclusion. According to the *Guide*'s rules of evidence, available studies provide insufficient evidence to assess the effectiveness of community-wide education-only interventions regarding improving knowledge or attitudes regarding vaccinations or in improving delivery of vaccinations. Only one qualifying study was identified that assessed the effectiveness of community-wide education-only interventions regarding delivery of vaccinations. That study had limitations in design and conduct and found inconsistent results in different subpopulations. No qualifying studies were identified evaluating the effectiveness of community-wide education-only interventions regarding knowledge and attitudes. However, community-wide education is a

component of many effective multicomponent interventions.

Clinic-Based Education Only

Definition. Clinic-based education-only interventions provide information to groups served in a specific medical or public health clinical setting. Interventions that have additional features (e.g., reminders), are used in combination with other interventions (e.g., multicomponent interventions that include education), or are provided in other settings (e.g., schools or child care centers) are reviewed elsewhere in this paper.

Background. Clinic-based education-only interventions might include informational brochures (e.g., "Vaccine Information Statements"), videotapes, or posters that could enable the client to take advantage of available services in the clinic. "Vaccine Information Statements" are commonly used standardized informational statements that are available to all providers of vaccinations and are distributed to clients both to provide information and to obtain consent for vaccination.

Review of evidence: effectiveness. Our search identified five studies regarding the effectiveness of clinic-based education-only interventions.[118,135–138] Of these, two[136,137] had limited execution and were, therefore, not included in the review. Details regarding the three qualifying studies are provided at the website: http://web.health.gov/communityguide. One randomized trial[118] comparing a combination of printed client educational materials and provider education with provider education only found nonsignificant increases in vaccination coverage of 3% for influenza (baseline, 23%) and 2% for pneumococcal (baseline, 3%) vaccines. Two before/after studies evaluated the effect of "Vaccine Information Statements" regarding parental knowledge and attitudes. One[135] found a significant increase in client knowledge regarding vaccines and desire to have their child vaccinated; the other study[138] found no statistically significant effect regarding parental beliefs.

Review of evidence: other positive or negative effects. No information regarding other positive or negative effects was sought in this review.

Conclusion. According to the *Guide*'s rules of evidence, available studies provide insufficient evidence to assess the effectiveness of clinic-based education-only interventions regarding improving vaccination coverage. Only one qualifying study evaluating the effectiveness of printed educational materials regarding improving vaccination coverage was identified. That study found effects regarding coverage that were neither substantial nor statistically significant. Only two studies were identified that evaluated the effects of vaccination information statements regarding client knowledge or attitude toward vaccination. Those studies demonstrated variable effects regarding knowledge and attitudes. No studies were identified evaluating clinic-based educational strategies other than printed educational materials.

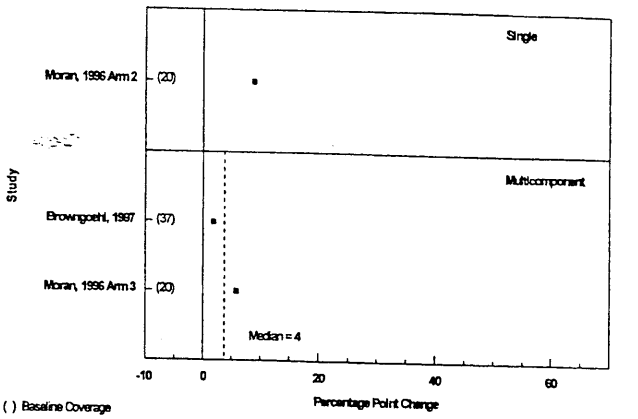


Figure 4. Percentage point change in vaccination coverage attributable to client or family incentives from studies that qualified for inclusion in the review.

Client or Family Incentives

Definition. Client incentives involve providing financial or other incentives to motivate persons to accept vaccinations. Incentives can be either rewards or penalties. Some interventions with aspects of incentives (e.g., WIC programs and child care, school, and college attendance requirements) are reviewed elsewhere in this paper.

Background. Client incentives are based on the assumption that clients will be motivated to seek vaccinations for themselves or their children if they receive rewards (e.g., baby toys, money, or discount coupons for retailers) or to avoid penalties (e.g., being excluded from participating in a program).

Review of evidence: effectiveness. Our search identified three studies regarding the effectiveness of incentives.[33,65,84] All three of those studies were admissible for inclusion in the review, and details regarding those studies are provided in Figure 4 and at the website: http://web.health.gov/communityguide. One additional paper provided more information regarding an already included study.[89]

The qualifying studies reported on one intervention arm that evaluated using incentives only and three intervention arms that evaluated incentives used with reminders with or without other interventions. One randomized controlled trial[65] was conducted among adults in a community health center. That study evaluated the effectiveness of a lottery for a $50 gift certificate for groceries offered alone or combined with

mailed client reminders to improve acceptance of influenza vaccination. The study found that percentage point changes for influenza were 9% (significant) when the incentive was used alone and 6% (nonsignificant) when combined with reminders; baseline coverage was 20%. A group randomized trial,[84] which was conducted in a public health center among children, evaluated a lottery for $25 to $100 cash prizes together with mailed client reminders. Change in delivery of at least 1 antigen was 18% during the study period. (This could not be converted to a percentage point change). A retrospective cohort study[33] among parents of children in a Medicaid managed care group gave $10 gift certificates when vaccinations were obtained in conjunction with a multicomponent strategy that included provider and parent reminders, home visiting, transportation assistance, and provider education. Differences in coverage with DPT, OPV, MMR, and Hib at age 35 months was 2% (nonsignificant); baseline coverage was 37%. No studies of positive incentives other than lottery-type incentives or gift certificates, nor studies of negative incentives, were identified.

Review of evidence: other positive or negative effects. No information regarding other positive or negative effects was sought in this review.

Barriers to intervention implementation. Potential barriers to incentives include ethical concerns regarding the potential for coerciveness of these interventions.

Conclusion. According to the *Guide*'s rules of evidence, available studies provide insufficient evidence to assess the effectiveness of client or family incentives for improving vaccination coverage. Evidence is insufficient because of the (1) small number of available studies; (2) variability in interventions evaluated; and (3) two of the four qualifying studies found results that were neither substantial nor statistically significant.

Client-Held Medical Records

Definition. Client-held medical records that indicate which vaccinations have been received are provided to members of a target population or their families.

Background. Client-held medical records can be used to assess a client's immunization status in medical and other settings and can improve a client's awareness of vaccinations needed or due. State and local health departments and providers have encouraged use of client-held medical records to varying degrees. Client-held medical records could result in improvements in vaccination coverage by (1) increasing client knowledge regarding and demand for vaccinations; (2) reducing missed opportunities to vaccinate in health care settings; or (3) a combination of the two.

Review of evidence: effectiveness. Our search identified eight studies regarding the effectiveness of client-held medical records.[28,105,117,139–143] Of these, four had limited execution and were not included in the review.[105,139,141,142] Details regarding the four qualifying studies are provided at the website: http://web.health.gov/communityguide. One of the studies compared the combination of a client-held record and a provider reminder with provider reminders only.[143] Other studies evaluated client-held records in conjunction with clinic-based education,[117] client reminders,[140] or multiple strategies.[28] One study[140] reported that "coverages were >45% in both groups" after the intervention and that differences between the groups were not significant. However, that study did not present data that could be expressed as a percentage point change in coverage. The other three studies reported percentage point changes in coverage ranging from 5% to 15%; some findings reached a level of statistical significance but others did not.

Review of evidence: other positive or negative effects. All qualifying studies found increases in the use of some other preventive or clinical services. No information regarding other positive or negative effects were sought in this review.

Barriers to intervention implementation. A potential barrier to the use of client-held medical records includes a possible burden placed on providers. One provider survey found that 80% of providers surveyed reported positive or very positive overall reactions to a "health diary" but 17% of providers believed that such records negatively affected client flow.[117]

Conclusion. According to the *Guide*'s rules of evidence, available studies provide insufficient evidence to assess the effectiveness of client-held medical records in improving vaccination coverage. Evidence is insufficient because of the: (1) small number of studies; (2) limitations in study design and conduct; (3) variability in interventions evaluated; and (4) several of the reported results were neither substantial nor statistically different from zero.

Research Issues for Increasing Community Demand for Vaccinations

Effectiveness. The effectiveness of recommended and strongly recommended interventions in this section (multicomponent interventions that include education; client reminder/recall; and vaccination requirements for child care, school, and college attendance) is established. However, research questions regarding the effectiveness of these interventions remain.

- What particular characteristics of interventions to increase community demand for vaccinations contribute to increased or lessened effectiveness?
- How do content, specificity, method of delivery, and

frequency of delivery of reminder/recall contribute to effectiveness?
- How do cultural characteristics of clients contribute to increased or lessened effectiveness of different interventions?
- What is the relative effectiveness of reminder and recall systems?
- What are the least and most effective combinations of services in multicomponent interventions?
- How does the effectiveness of vaccination requirements for child care, school, and college attendance vary by specific requirements of legislation and vigorousness of enforcement?
- Do registries provide a functional backbone for effective interventions, including multicomponent interventions that include education or client reminder/recall?

Because the effectiveness of community-wide education-only interventions, clinic-based education-only interventions, client or family incentives, and client-held medical records regarding improving vaccination coverage has not been established, basic research questions remain.

- Are these interventions effective in improving vaccination coverage?
- Do these interventions promote positive or negative attitudes toward vaccination among target populations?
- What attributes of clinic-based or community-wide educational programs—medium, message, intensity—contribute to effectiveness or lack thereof?
- What attributes of incentives (e.g., type or amount) contribute to effectiveness or lack thereof?
- Do multiple competing prevention messages act in ways that are synergistic or interfering?
- Do client-held medical records reduce missed opportunities for vaccination?

Applicability. Each recommended and strongly recommended intervention should be applicable in most relevant target populations and settings. However, possible differences in the effectiveness of each intervention for specific subgroups of the population could not be determined. Several questions regarding the applicability of these interventions in settings and populations other than those studied remain.

- Are these interventions effective in improving vaccination coverage in adolescents?
- Do meaningful differences exist in effectiveness of these interventions based on the level of scale at which they are delivered (i.e., community-wide systems from a registry versus managed care-based systems versus practice-based systems)?

Other Positive or Negative Effects

With the exception of some discussion of improved use of other clinical and preventive care, the studies included in this review did not report on other positive or negative effects of these interventions. Therefore, research regarding the following questions would be useful:

- Do interventions implemented at the community level (e.g., community-wide education-only interventions or multicomponent interventions that include education) result in positive outcomes other than improved vaccination coverage (e.g., community empowerment)?
- Do clinic-based interventions to increase client demand for vaccinations interfere with office flow or efficiency, and if so, how can this effect be minimized?
- Do child care, school, and college vaccination requirements interfere with the other activities of the settings, and if so, how can that effect be minimized?
- Do these interventions result in other positive changes in disease prevention or health care as well as improving vaccination coverage?

Economic evaluations. In general, available economic information was sparse; therefore, considerable research is warranted regarding the following questions:

- What are the costs of these interventions?
- How do the costs per additional child vaccinated compare with other interventions to improve vaccination coverage?
- Can strategies that are designed to improve vaccination coverage and other outcomes concurrently improve cost-effectiveness of these strategies?
- How do specific characteristics of these interventions contribute to economic efficiency?
- What are the relative economic consequences of reminder and recall systems?
- What characteristics of reminders or recall (e.g., frequency, content, or method of delivery) are the most cost-effective?
- What combinations of components in multicomponent interventions are most cost-effective?
- What is the cost-benefit or cost-utility of these interventions?

Barriers. How can these interventions be implemented with minimal administrative burden placed on providers or systems?

- Do community-wide registries reduce barriers to use or increase use of these interventions?

Enhancing Access to Vaccination Services

Interventions that enhance access to vaccination services are designed to reduce the cost or to increase the

convenience of obtaining vaccinations. Interventions that enhance access to vaccination services reviewed in this paper include reducing out-of-pocket costs, expanding access in health care settings, and vaccination interventions in non-medical settings, including vaccination programs in WIC settings, home visits, vaccination programs in schools, and vaccination programs in child care centers.

Reducing Out-of-Pocket Costs

Definition. Reducing out-of-pocket costs to families for vaccinations or administration of vaccinations can be implemented by paying for vaccinations or administration, providing insurance coverage, or reducing co-payments for vaccinations at the point-of-service.

Background. The out-of-pocket costs of vaccination are commonly cited by clients and providers as a barrier to obtaining vaccinations.[144] Many interventions have been used by the U.S. government (e.g., the Vaccines for Children Program), state governments (e.g., provision of free vaccinations), and managed care organizations (e.g., reducing co-pays) to reduce this barrier. Reducing out-of-pocket costs can result in increases in vaccination coverage either by improving availability of vaccinations or increasing demand for vaccinations.

Review of evidence: effectiveness. Our search identified 26 studies regarding the effectiveness of reducing out-of-pocket costs.[28,30,35,56,67,71,76,101,108,110,116,145–159] Two additional papers provided more information regarding an already included study.[160,161] Seven studies had limited execution and were therefore not included in the review.[56,101,110,116,146,152,155] Details of the 19 qualifying studies are provided at the website: http://web.health.gov/communityguide. Of the qualifying studies, 14 evaluated the effectiveness of reducing out-of-pocket costs regarding improving vaccination outcomes[28,30,35,67,71,76,108,147–150,153,156,158]; four evaluated the effectiveness of these interventions regarding improving provider-reported likelihood of referring clients elsewhere for vaccinations,[145,151,154,159] and one evaluated both vaccination and referrals.[157]

Of the studies evaluating vaccination outcomes, seven evaluated reducing out-of-pocket costs as a single-component intervention, and eight evaluated multicomponent interventions that included reducing out-of-pocket costs. Multicomponent interventions included client reminder/recall,[28,30,67,71,76] community-wide education,[30,108] expanding access in health care settings,[67,156] provider education,[30,108] clinic-based education,[28] client-held medical records,[28] WIC interventions,[148] and provider reminder/recall.[28]

Two studies evaluating the effects regarding coverage of single-component interventions suggested increased[150] or earlier[158] vaccination, but did not present results that could be expressed as a percentage point change in coverage. The remaining 13 studies reported on 15 intervention arms that found median percentage point changes in coverage ranging from −8% to 47% (median, 15%). The five studies of single-component interventions that could be expressed as percentage point changes in coverage reported on six intervention arms that found changes in coverage ranging from −1% to 29% (median, 10%). Eight studies evaluating the effects of multicomponent interventions regarding coverage reported on nine intervention arms and found median percentage point changes in coverage ranging from −8% to 47% (median, 16%).[28,30,67,71,76,108,148,156]

Five provider surveys[145,151,154,157,159] with fair or good execution found that providers reported being more likely to refer children with less public or private insurance coverage to other sites for vaccination. Two of these studies[154,159] were nationally representative surveys of pediatricians and family physicians.

Review of evidence: applicability. The same body of evidence used to assess effectiveness was used to assess the applicability of these interventions of different settings, populations, and vaccines. Studies have included children[35,147,148,153,156–158] and adults.[30,67,71,76,108,149,150] Adolescents have been studied in mother-infant pairs[28] but not regarding their own vaccinations. Studies have been performed in urban[28,67,108,148,156] and rural[30,149] settings, and in populations with low[28,148,153,156] and mixed[150,158] socioeconomic status. Settings in which reduced cost vaccinations were provided included hospitals,[28,149] clinics,[147,149] private offices,[157,158] WIC sites,[148] and emergency departments.[156]

Review of evidence: economic. Our search identified one economic evaluation of interventions offering free or discounted vaccinations.[71] Details of this study are provided at the website: http://web.health.gov/communityguide. This study evaluated the cost-effectiveness ratio of a multicomponent intervention offering mailed reminders and free vaccine to encourage influenza vaccination. The adjusted cost-effectiveness ratio of this intervention compared with no intervention on the basis of this study was $43/additional vaccination.

Review of evidence: other positive or negative effects. Our search did not identify any studies related to the question of whether reducing out-of-pocket costs negatively affects vaccine research and development. No other positive or negative effects of this intervention were sought in this review.

Barriers to intervention implementation. Potential barriers to implementation of reducing out-of-pocket costs include fragmentation of payment mechanisms.

Conclusion. According to the *Guide*'s rules of evidence, strong scientific evidence exists that reducing out-of-pocket costs for vaccinations is effective in improving vaccination coverage.

Expanding Access in Health Care Settings

Definition. Expanding access increases the availability of vaccines in medical or public health clinical settings in which vaccinations are offered by: (1) reducing the distance from the setting to the population; (2) increasing or changing hours during which vaccination services are provided; (3) delivering vaccinations in clinical settings in which they were previously not provided (e.g., emergency departments, inpatient units, or subspecialty clinics); or (4) reducing administrative barriers to obtaining vaccination services within clinics (e.g., developing a "drop-in" clinic or an "express lane" vaccination service).

Background. Surveys of client attitudes and behaviors have identified inconvenience of obtaining vaccinations as a major barrier toward improving vaccination rates in children.[144] This factor might be particularly important for disadvantaged, low-income families, many of whom have large families and little financial support for child care or transportation.

Review of evidence: effectiveness. Our search identified 25 studies regarding the effectiveness of expanded access.[27,31–33,36,37,57,63,67,72,73,84,101,103,107,110,111,116,119,139,146,156,162–164] Four additional papers provided more information regarding an already included study.[86,88,89,91] Nine studies were not included in the review because of limited execution.[27,101,103,110,116,119,139,146,163] Details regarding the 16 qualifying studies are provided at the website: http://web.health.gov/communityguide. The qualifying studies provided data regarding two intervention arms that evaluated expanding access only and 15 intervention arms that included expanded access combined with other interventions. Types of expanded access included drop-in clinics,[32,57,63,67,72] increased hours on nights and weekends,[31,84,107] providing vaccinations in emergency departments,[156,164] dedicated vaccination clinics,[73,111] special vaccination appointments,[36,37] vaccination stations for inpatients,[162] and transportation assistance.[33] Most multicomponent interventions included client reminder/recall.[31–33,36,37,57,63,67,72,84] Other components used with expanded access included provider education,[31–33,36,63] clinic-based education,[31,33,36,107] reducing costs,[32,67,156] standing orders,[63,72,162] community-wide education,[32,111] client incentives,[33] WIC interventions,[32] home visiting,[33] and assessment and feedback.[36]

Three qualifying studies[84,111,162] presented data that could not be expressed as a percentage point change in coverage. The remaining studies presented data regarding 12 multicomponent intervention arms and 2 single-component intervention arms. The overall median percentage point change was 10% (range, −8% to 35%). Two studies that evaluated expanded access only found median percentage point changes of 3% and 7%; only one of these reached a level of statistical significance. Studies that evaluated expanding access in combination with other interventions found a median percentage point change of 13% (range, −8% to 35%).

Any of several reasons could explain the fact that multicomponent interventions that include expanding access were effective in improving vaccination coverages, whereas expanding access only had less convincing evidence of effectiveness. Possibly, this finding reflects:

- the existence of more studies of multicomponent interventions;
- greater intensity and, thus, greater effectiveness of multicomponent interventions; or
- synergy between components of multicomponent interventions (i.e., the whole is more effective than the sum of the parts).

Another possibility is that only expanding access might not cause large increases in acceptance of vaccinations by itself but could increase the feasibility of using other components (e.g., standing orders or reminders).

Review of evidence: applicability. The same body of evidence used to assess effectiveness was used to assess the applicability of these interventions to different settings, populations, and vaccines. Populations have included adults[36,37,57,63,67,72,73,162] and children.[31–33,84,111,156,164] Adolescents have been studied in mother-infant pairs but not regarding their own vaccinations.[107] Studies have been conducted in a variety of settings including managed care,[33,63] community clinics,[57,67] Veterans' Administration hospitals and clinics,[72,162] academic settings,[37,107] private practices,[36] public health clinics,[31,84] and as a part of community-wide interventions.[32,111] Neither of the two studies of emergency department vaccination programs[156,164] found results that were substantial or significantly different from zero.

Review of evidence: other positive or negative effects. No other positive or negative effects were sought in this review.

Review of evidence: economic. Our search identified one economic evaluation of a multicomponent intervention that included expanding access.[120] Details of that study are provided at the website: http://web.health.gov/communityguide. That study estimated the costs of an intervention that included expanding access to vaccination services, multiple education and health promotion activities, and possibly, provider assessment and feedback. The adjusted estimate of average program costs based on that study is $7.65/vaccination delivered.

Barriers to intervention implementation. Potential barriers to implementation of programs to expand access to vaccination services in medical settings include: (1) difficulties coordinating between settings; (2) lack of appropriate records; (3) clients' difficulty accurately

recalling immunization status; (4) high numbers of clients with contraindications to vaccinations (e.g., high numbers of febrile children in emergency department settings); and (5) lack of a relationship between vaccination programs and primary missions of settings.

Conclusion. According to the *Guide*'s rules of evidence, strong scientific evidence exists that, as a part of multicomponent interventions, expanding access improves vaccination coverage among children and adults and improves vaccination coverage in a range of contexts. Insufficient evidence exists to assess the effectiveness of expanding access by itself because of the: (1) small number of studies; (2) results that are small and statistically nonsignificant; and (3) limitations in study design and execution.

Vaccination interventions in nonmedical settings. Vaccination interventions in nonmedical settings involve efforts to encourage vaccination of important target populations in places where they congregate (e.g., child care centers, schools, and WIC locations). At a minimum, these interventions involve assessment of each child's immunization status and either referral of underimmunized persons to health care providers or provision of vaccinations on-site. Other services can include education, provision of vaccinations, and incentives to accept vaccinations.

Vaccination Programs in the Special Supplemental Nutrition Program for Women, Infants, and Children Settings

Definition

Vaccination programs in WIC settings involve efforts to encourage vaccination of a low-income target population in this nonmedical setting. At a minimum, vaccination-promoting strategies in WIC require assessment of each child's immunization status and referral of underimmunized children to a health care provider. Other services can include education, provision of vaccinations, or incentives to accept vaccinations (e.g., monthly voucher pickup, which requires more frequent WIC visits when children are not up-to-date).

Background. The Special Supplemental Nutrition Program for Women, Infants, and Children is a federal grant program administered by the U.S. Department of Agriculture and implemented through state health departments and American Indian and Alaska Native tribal organizations. WIC provides supplemental foods, health care referrals, and nutrition education for low-income women, infants, and children who are found to be at nutritional risk. The program is required to serve as a gateway to, and coordinator for, other health services, including vaccinations. WIC is the single largest point of access to health-related services for low-income preschool children. The program serves over 45% of the U.S. birth cohort and, in some cities, serves up to 80% of low-income infants. In general, participants visit WIC sites every two to three months to receive nutrition services and to pick up food vouchers; more comprehensive health status evaluations are conducted every six to twelve months. Voucher restrictions are used to closely monitor high-risk clients in the WIC program. They require families to return to the WIC site more frequently than would otherwise would have been required, usually monthly. Here, such requirements are referred to as *monthly voucher pick up.*

Review of evidence: effectiveness. Our search identified ten studies regarding the effectiveness of WIC interventions.[32,148,165–172] One additional paper provided more information regarding an already included study.[173] Six studies were not included in the review because of limited execution.[167–172] Details regarding the four qualifying studies are provided at the website: http://web.health.gov/communityguide. Three studies were conducted entirely among WIC clients. One study compared education, assessment, referral, and either escort to a vaccination clinic or monthly voucher pickup with education, assessment, and referral only. Both intervention arms resulted in relatively small (approximately 4% percentage point changes in both groups) but significant improvements in vaccination coverage from baseline coverages of 94%. Two studies compared WIC interventions with no intervention. One of these compared various combinations of education, assessment, referral, free vaccinations, and monthly voucher pickup with usual care and found a 9% percentage point change in the intervention groups relative to the control group and few substantial differences between intervention groups.[166] The other study compared assessment, education, monthly voucher pickup, and free vaccinations plus various combinations of referrals for vaccination or on-site vaccination provision. That study found a 34% percentage point change in vaccination coverage and did not find substantial differences in effectiveness based on specific strategies used for vaccination provision or referral.[148] A final study used WIC interventions as part of a comprehensive multicomponent intervention and found a 12% improvement in coverage attributable to all components combined.[32]

Review of evidence: applicability. The same body of evidence used to assess effectiveness was used to assess the applicability of these interventions to different settings, populations, and vaccines. All qualifying studies were conducted in urban areas among disadvantaged, predominantly minority, children. These studies did not include nonurban areas or nonminority populations.

Review of evidence: other positive or negative effects. Many WIC providers are concerned that vaccination requirements or monthly voucher pickup will serve as a disincentive for WIC participation. Two qualifying studies evaluated the effect of WIC programs regarding dropout rates. One of these[165] enrolled 377 children who received assessment and escort, 281 children who received assessment and referral, and 178 children who received assessment and monthly voucher pickup. Nine children (eight at voucher sites) dropped out during the study period. Another study[148] found that dropout rates remained stable over time in the intervention group (average 40%) but increased over time in the comparison group (average 34%). These data (small absolute dropout rates in one study and small absolute differences in dropout rates in another study) do not demonstrate that vaccination interventions in WIC cause substantial increases in WIC dropout.

Review of evidence: ecomonic. Our search identified two economic evaluations of WIC interventions[148,173] One of these reported cost-effectiveness ratios of three different variations of a WIC intervention differing primarily in methods of referral or vaccination provision.[148] Details of that study are provided at the website: http://web.health.gov/communityguide. Adjusted cost-effectiveness ratios based on that study ranged from $34 to $84/fully vaccinated child. Adjusted average cost of assessments based on a second study[173] were $2.65/assessment, for interventions using an on-site vaccination nurse, and $1.28/assessment, for interventions using other strategies to promote vaccination.

Barriers to intervention implementation. Barriers to implementation of a vaccination program in WIC settings might include difficulties coordinating two programs and philosophical objections to monthly voucher pickup policies among some WIC providers and managers.

Conclusion. According to the *Guide*'s rules of evidence, sufficient scientific evidence exists that interventions in WIC settings are effective in improving vaccination coverage.

Home Visits

Definition. Home visits to promote vaccinations involve providing face-to-face services to clients in their homes. Services can include education, assessment of need, referral, and provision of vaccinations. Home-visiting interventions also can involve telephone or mail reminders.

Background. In the United States, home-visiting interventions are usually targeted toward subpopulations that are difficult to reach (e.g., those persons living in public housing communities or persons living in rural areas).

Review of evidence: effectiveness. Our search identified 15 studies regarding the effectiveness of home visits to improve vaccination coverage.[33,73,174–186] One additional paper provided more information regarding an already included study.[89] Of these, eight had limited execution and were therefore not included in the review.[174,177–181,184,185] One study evaluated home visits both as a component of a complex multicomponent intervention and as used alone.[33] The evaluation of home visits only in that study had limited execution; therefore, only the multicomponent intervention from that study is included in this review. Details of the seven qualifying studies are presented at the website: http://web.health.gov/communityguide. Five studies evaluated home visiting with or without client reminders and case management.[73,175,176,182,186] Two studies[33,183] evaluated complex multicomponent strategies including home visits. These 7 studies found changes in vaccination coverages ranging from −1% to 49% (median, 10%). Two studies of home-visiting-only interventions found median percentage point changes in coverage of −1% and 10%. Multicomponent interventions demonstrated median percentage point changes in coverage ranging from 2% to 20% (median, 13%).

Review of evidence: applicability. The same body of evidence used to assess effectiveness was used to assess the applicability of these interventions to other settings, populations, and vaccines. Studies included adults[73,175] and children.[33,176,182,183,186] Many studies included urban populations[33,182,183,186] and clients of low socioeconomic status.[33,182,183,186] One study included rural populations.[182] Home visits have not been studied among adolescents or in interventions to increase delivery of hepatitis B or pneumococcal vaccinations.

Review of evidence: other positive or negative effects. No other positive or negative effects of this intervention were sought in this review.

Review of evidence: ecomonic. Our searches identified four economic evaluations of home visits.[179,182,186,187] Two reported cost-effectiveness ratios,[182,186] and two reported average costs.[179,187] Details of these studies are provided at the website: http://web.health.gov/communityguide. Adjusted average costs based on the data in those studies were $22/child vaccinated and $130/vaccination. Adjusted cost-effectiveness ratios based on those studies ranged from $513 to $13,020 per additional vaccination.

Barriers to intervention implementation. Potential barriers to implementing home-visiting programs include need for staff training and concerns regarding staff safety.

Conclusion. According to the *Guide*'s rules of evidence, sufficient scientific evidence exists that home-visiting interventions are effective in improving vaccination

coverage. However, at least when applied only to improve vaccination coverage, home-visiting interventions can be highly resource-intensive relative to other available options for improving vaccination coverage.

Vaccination Programs in Schools

Definition. School-based vaccination interventions are intended to improve delivery of vaccinations to school attendees aged approximately 5 to 18 years. School-based interventions usually include vaccination-related education of students, parents, teachers, and other school staff plus either provision of vaccinations or referral for vaccinations. These interventions can also involve other components (e.g., providing incentives and acquiring written consent from parents or guardians). Vaccination requirements for school attendance are reviewed elsewhere in this paper.

Background. School-based vaccination programs could provide a unique opportunity for reaching adolescents to provide vaccinations and other preventive services because in the United States, approximately 99% of children aged 11 and 12 years attend school.[188] School-based vaccination programs could track each student's immunization status, identify those who have missed doses, and ensure vaccine series completion (e.g., with hepatitis B vaccine) among most students. School-based vaccination programs are often collaborations between schools, local health departments, private hospitals, and community clinics.

Review of evidence: effectiveness. Our search identified four studies regarding the effectiveness of school-based vaccination programs for improving coverage.[51,75,109,189] Of these, three had limited execution and were not included in the review.[51,75,109] Details of the single qualifying study are provided at the website: http://web.health.gov/communityguide. The qualifying study[189] evaluated a school-based program to increase delivery of hepatitis B vaccinations to adolescents; the study used multiple components including teacher education, classroom lessons, written client educational materials, and peer and individual incentives to encourage children to bring in their consent forms. Results demonstrated: (1) generally positive attitudes toward vaccinations among students and teachers; (2) significant improvements in client knowledge regarding hepatitis B; (3) faster return of consent forms among schools when incentives were used; and (4) vaccination coverage with three doses of hepatitis B vaccine after the intervention of 66% (comparative data not available).

Review of evidence: other positive and negative effects. No information regarding other positive or negative effects was sought in this review.

Barriers to intervention implementation. Potential barriers to implementation of vaccination programs in schools might include difficulties coordinating between different programs, need for staff training, disruption of school routines, and concerns regarding confidentiality.

Conclusion. According to the *Guide*'s rules of evidence, available studies provide insufficient evidence to determine the effectiveness of school-based vaccination interventions. Evidence is insufficient because of (1) the small numbers of available studies; (2) limitations in their design and execution; and (3) lack of comparative studies regarding the effectiveness of these interventions to improve vaccination coverage.

Vaccination Programs in Child Care Centers

Definition. Interventions in child care centers involve efforts to encourage vaccination of children aged <5 years. These interventions require assessment of each child's immunization status at: (1) entry into child care; (2) at some point during the child's enrollment; or (3) at periodic intervals throughout the child's enrollment. Vaccination interventions in child care centers can also include education or notification of parents, referral of underimmunized children to health care providers, and possibly, provision of vaccinations on-site. Vaccination requirements for entry into child care centers are reviewed elsewhere in this paper.

Background. Children in child care centers are at increased risk for communicable diseases.[190] In 1995, approximately 31% of preschool age children were being cared for in child care centers (*Report of the Children's Health Working Group*, March 1998 Draft). Interventions in child care centers can result in increased attendance in clinical settings through referrals or possibly by directly increasing coverage through delivering vaccinations on-site.

Review of evidence: effectiveness. Our search identified only one study[191] regarding the effectiveness of interventions in child care centers to improve vaccination coverage. That study was not included in the review because of limited execution. Absence of qualifying studies does not allow us to make an assessment of the effectiveness of child care center programs.

Review of evidence: other positive or negative effects. No other positive or negative effects were sought in this review.

Conclusion. According to the *Guide*'s rules of evidence, available studies provide insufficient evidence to assess the effectiveness of interventions in child care centers because only one study was identified and it could not be included in this review because of limitations in its design and execution.

Research Issues for Enhancing Access to Vaccination Services

Effectiveness

The effectiveness of recommended and strongly recommended interventions in this section (i.e., reducing out-of-pocket costs, expanding access in health care settings as part of multicomponent interventions, home visits, and vaccination interventions in WIC settings) is established. However, research issues, which contribute to increased or lessened effectiveness, remain regarding the characteristics of these interventions. For example,

- Are programs to reduce out-of-pocket costs similarly effective among persons who are and who are not economically disadvantaged?
- What are the relative effectiveness and economic consequences of strategies that provide home visits for all persons in a defined population versus those that use staged protocols using less-intensive interventions (i.e., reminders) to reach some clients and reserve actual home visits for clients who are hardest to reach?
- What are least and most effective combinations of services in multicomponent interventions that incorporate increasing access to vaccination services in health care settings?
- What are the least and most effective combinations of services in WIC interventions?
- How accurate are vaccination data in WIC settings, and how does data accuracy impact effectiveness?

Because the effectiveness of vaccination programs in child care centers, vaccination programs in schools, and single-component interventions to increase access to vaccination in health care settings has not been established, basic research questions remain.

- Are these interventions effective in improving vaccination coverage?
- Of the range of strategies that have been used to expand access to vaccination services in health care settings, which are the most and least useful?
- What attributes of these programs contribute to effectiveness or lack thereof?

Applicability

Each recommended and strongly recommended intervention should be applicable in most relevant target populations and settings. However, possible differences in the effectiveness of each intervention for specific subgroups of the population could not be determined. Several questions regarding the applicability of these interventions in settings and populations other than those studied remain.

- What strategies would be most effective for improving access to vaccinations among adolescents?
- Is effectiveness of WIC interventions in rural areas similar to that described in urban areas?

Other Positive and Negative Effects

In general, studies included in this review did not report on other positive and negative effects of these interventions. Therefore, research regarding the following questions would be useful:

- Do programs to reduce out-of-pocket costs adversely affect development or adoption of new vaccines?
- Do any of these interventions have positive or negative effects regarding subsequent use of primary care?
- Do home visits result in identification of child abuse or neglect?
- Do home visits result in reporting of possible abuse or neglect that is not subsequently confirmed?
- Do WIC interventions result in dropout?
- Do interventions to increase access to vaccinations in health care settings interfere with other functions of these settings, and if so, how can this effect be minimized?
- Do these interventions result in other positive changes in use of preventive services or health care as well as improving vaccination coverage?

Economic Evaluations

In general, available economic information was sparse. Therefore, considerable research is warranted regarding the following questions:

- What are the costs of these interventions?
- How do costs per additional child vaccinated compare with other interventions to improve vaccination coverage?
- Are home-visiting programs cost-effective relative to other interventions to improve vaccination coverage?
- Can strategies that are designed to improve vaccination coverage and other outcomes concurrently improve cost-effectiveness of these strategies?
- Are home-visiting programs that address more than one issue more or less cost-effective than programs addressing vaccinations only?
- How do specific characteristics of these interventions contribute to economic efficiency?
- What are the relative economic consequences of universal programs to reduce out-of-pocket costs versus programs intended for persons whose need is greatest?
- What combinations of components in multicomponent interventions are most cost-effective?
- Are staged home-visit protocols more cost-effective than those that are not?
- What are the most cost-effective combinations of services for WIC programs?

- What is the cost-benefit or cost-utility of these interventions?

Barriers

- How can these interventions be implemented with minimal administrative burden placed on providers or systems and minimal disruption of the settings' primary missions?
- How can reducing out-of-pocket costs be effectively implemented given the fragmentation of payment mechanisms in the United States?
- Can registries help to overcome lack of current immunization status that is sometimes a barrier to implementing these interventions?

Provider-Based Interventions

In the United States, most people accept the need for vaccinations, and they are seen periodically in health care settings. Unfortunately, providers often miss opportunities to vaccinate. Provider-based interventions are implemented primarily through health care systems in settings with the goal of reducing missed opportunities. The provider-based interventions reviewed in this paper include provider recall/reminder, provider assessment and feedback, standing orders, and provider education-only interventions.

Provider Reminder/Recall

Definition. Provider reminder/recall interventions inform those who administer vaccinations that individual clients are due (reminder) or overdue (recall) for specific vaccinations. Techniques by which reminders are delivered—in client charts, by computer, by mail, or other—and content of reminders can vary. Interventions that incorporate elements of both reminders and standing orders are reviewed with standing orders in this paper.

Background. Provider reminder/recall systems make information regarding the client's immunization status available to providers either manually or through a computerized system. This information is then conveyed to the provider before, during, or after a scheduled appointment.

Review of evidence: effectiveness. Our search identified 60 studies regarding the effectiveness of provider reminder/recall.[36–38,42,43,52,53,64,69,74,78,102,104,106,110,112–115,139,141,152,155,164,177,182,192–225] Eight additional papers provided more information regarding an already included study.[86,90,92,93,226–229] Thirty-one studies were not included in the review because of limited execution[69,102,104,110,112,113,115,139,141,152,155,177,193,194,213–218,220] or least suitable designs.[53,78,108,192,197,198,202,210,211,224] Details of the 29 qualifying studies are provided at the website: http://web.health.gov/communityguide. The qualifying studies reported on 21 intervention arms evaluating provider reminder/recall only and 15 evaluating multicomponent interventions including provider reminder/recall. Interventions typically involved chart reminders, checklists, or flowcharts, or computerized reminders made available to providers at the time of client visits. One study evaluated letter reminders sent from an emergency department between clinic visits.[164] Multicomponent interventions also included client reminder/recall,[36,38,42,43,52,74] clinic-based education,[36,37,42,114,205] provider assessment and feedback,[36,42,182,204,205,209,223] provider education,[36,182,209] community-wide education,[38] and expanded access.[36]

Five qualifying studies presented data regarding one or more intervention arms that could not be expressed as a percentage point change in coverage.[38,114,164,204,222] Remaining studies provided data regarding 17 single-component intervention arms and 12 multicomponent intervention arms. Overall, the studies found a median percentage point change in coverage of 17% (range, 1% to 67%). Studies that evaluated provider reminder/recall only found a median percentage point change in coverage of 17% (range, 1% to 67%). Studies that evaluated provider reminder/recall as part of a multicomponent intervention found a median percentage point change of 14% (range, 1% to 36%).

Review of evidence: applicability. The same body of evidence used to assess effectiveness was used to assess the applicability of these interventions to different settings, populations, and vaccines. Affected populations included adults,[36,37,42,43,52,60,64,74,114,195,196,199–201,203,206–209,212,219,225] adolescents,[204] and children.[38,164,182,205,221] Studies have included a range of providers including residents,[37,43,64,74,114,195,196,204–206,209,212,219,221–223] physicians who have completed their training,[36,37,64,74,161,173,174,179,190,191] and nonphysician vaccination providers.[36,37,64,74,206,207,207,212,221,222] Physician specialties included internal medicine,[36,43,114,196,201,206,209,212,219,222] family medicine,[36,37,52,64,74,195,203–205,207,225] and pediatrics.[221] Most studies have been done in outpatient settings, but inpatient settings are also represented.[200,208] Most studies have been done in academic clinical settings, but other settings are also represented including community health centers,[221,225] managed care,[42] private practice,[36,52] community hospitals,[200] and community-wide settings.[38] Studies have assessed the effectiveness of these interventions to improve vaccination delivery of MMR,[38,164,182,204,205,221] DTP,[164,182,205,221] OPV,[164,182,205,221] Hib,[164,182,221] influenza,[36,37,42,43,64,195,196,199–201,206,207,209,212,222] pneumococcal,[43,196,199,201,206–209,212,212,219] and Td.[43,52,64,74,114,196,203,222,225] We did not find studies of the effectiveness of this intervention to improve delivery of hepatitis B vaccinations.

Review of evidence: other positive or negative effects. Several qualifying studies that assessed nonvaccination outcomes (e.g., improved delivery of other preventive services or clinical care) found improvements in some outcomes other than vaccination.[74,196,212,222,223] Other positive or negative effects were not sought in this review.

Review of evidence: economic. Our search identified three studies.[52,93,192] Details of the studies are provided at the website: http://web.health.gov/communityguide. Data from a study estimating the cost-effectiveness of provider reminders-only documents an adjusted cost-effectiveness ratio of $0.70/additional vaccination. This cost-effectiveness ratio is probably an underestimate because it does not include the cost of producing reminders. A second study estimated the cost-effectiveness of an intervention that included both client and provider reminders.[52] The adjusted cost-effectiveness ratio based on that study was $4/additional vaccination. A final study estimated the cost-effectiveness of a program that assessed the immunization status of hospitalized children by contacting the children's usual physicians, and hospital physicians were reminded to vaccinate the children before they left the hospital.[192] The adjusted cost-effectiveness ratio based on that study was $300/ fully vaccinated child.

Barriers to intervention implementation. Five studies[139,182,207,218,221] found that some settings had difficulty placing reminders in charts or using reminders when provided. This suggests that administrative burden can be a barrier to reminder use. Lack of information infrastructure could also be a barrier to reminder use.

Conclusion. According to the *Guide*'s rules of evidence, strong scientific evidence exists that provider reminder/recall interventions are effective in improving vaccination coverage.

Assessment and Feedback for Vaccination Providers

Definition. Provider assessment and feedback involves retrospectively evaluating the performance of providers in delivering one or more vaccinations to a client population and giving this information to providers. Assessment and feedback interventions can also involve other activities (e.g., incentives or benchmarking [i.e., comparing performance to a goal or standard]).

Background. Provider assessment and feedback can result in improvements in vaccination coverage either by changing provider knowledge, attitudes, and behavior, or by stimulating use of additional changes in the vaccination delivery system (e.g., reminders or standing orders). Evaluation of provider assessment and feedback is timely because (1) information systems are improving and are increasingly common; (2) most vaccinations are delivered in the private sector; and (3) such quality-assurance approaches as the Health-plan Employer Data and Information Set (HEDIS) are being used more often.

Review of evidence: effectiveness. Our search identified 27 studies regarding the effectiveness of assessment and feedback.[36,42,47,58,69,81,139,182,194,197,204,205,209,211,213,218,220,223,230–238] Four additional papers provided more information regarding an already included study.[86,94,146,239] Thirteen studies were not included in the review because of limited execution.[69,81,139,194,211,213,218,220,231–233,237,238] Details regarding the 14 qualifying studies are provided at the website: http://web.health.gov/communityguide. Qualifying studies presented data regarding seven intervention arms evaluating assessment and feedback only and nine intervention arms evaluating assessment and feedback used as a part of a multicomponent intervention. Generally, assessment and feedback components of interventions were not described in detail (e.g., content, frequency, method of delivery, or associated characteristics such as benchmarking or incentives). Some studies reported on use of assessment and feedback only; several evaluated assessment and feedback used with financial[230,234] or nonfinancial[235] incentives. One study found that assessment and feedback to individual physicians might have been more effective than assessment and feedback to the chief of service, but alternative explanations for this finding exist. All but one of the multicomponent interventions[47] incorporated provider reminder/recall as well as assessment and feedback. Multicomponent interventions also included provider education,[36,182,197] client reminders,[36,42,47] and clinic-based education.[36,42,205]

Three qualifying studies[204,230,236] presented data that could not be expressed as a percentage point change in vaccination coverage. Remaining studies provided data regarding eight multicomponent intervention arms and five single-component intervention arms. Overall, these studies demonstrated increases in vaccination coverage ranging from 1% to 43% (median, 16%). Studies that evaluated provider assessment and feedback only found a median coverage increase of 16% (range, 9% to 41%). Studies that evaluated provider assessment and feedback as part of a multicomponent strategy found a median percentage point change of 17% (range, 1% to 43%). Several studies have demonstrated that improvements in coverage can be maintained or further improved over several years of follow-up.[197,234,235]

Review of evidence: applicability. The same body of evidence used to assess effectiveness was used to assess the applicability of these interventions to different settings, populations, and vaccines. Studies have included adults,[36,42,47,58,197,209,223,230,234] adolescents,[204] and children,[182,205,235,236] providers including resident

physicians,[197,204,205,209,234] physicians who have completed their training,[36,42,47,58,205,236] and nonphysician vaccination providers.[205] Physician specialties included internal medicine,[36,47,58,197,209,234] family medicine,[36,204,205] and general practice.[236] Studies have been conducted in a range of settings including private practice,[36,47,58] managed care,[42] public health,[235] and community health centers,[230] and academic settings.[197,204,205,209,223,234] Studies have assessed the effectiveness of these interventions to improve coverage with MMR,[182,204,205,235,236] DTP,[182,205,235,236] OPV,[182,205,235,236] Hib,[182] influenza,[36,42,47,58,197,209,230,234] pneumococcal,[197,223,234] and Td.[197,234] The body of evidence did not include studies of interventions to improve delivery of hepatitis B vaccinations.

Review of evidence: other positive or negative effects. Several qualifying studies that assessed nonvaccination outcomes (e.g., improved delivery of other preventive services or clinical care) found improvements in some outcomes other than vaccination.[197,223,230] Other positive or negative effects were not sought in this review.

Review of evidence: economic. No economic evaluations of assessment and feedback interventions were identified.

Barriers to intervention implementation. Potential barriers to use of assessment and feedback include lack of an adequate information infrastructure and administrative burden on providers and systems.

Conclusion. According to the *Guide*'s rules of evidence, strong scientific evidence exists that assessment and feedback of vaccination coverage information to providers are effective in improving vaccination coverage. The specific characteristics of assessment and feedback interventions (e.g., content, intensity, use of incentives, or benchmarking) that contribute most to effectiveness cannot be determined from available data; however, a variety of assessment and feedback interventions have been consistently effective in a wide range of contexts.

Standing Orders

Definition. Standing orders involve interventions in which nonphysician personnel prescribe or deliver vaccinations to client populations by protocol without direct physician involvement at the time of the interaction. Settings in which this occurs include clinics, hospitals, and nursing homes. Dedicated vaccination clinics often operate under standing orders, but we did not consider standing orders in that context as an intervention for the purposes of this paper.

Background. Requirements for physical examinations and lack of personnel to administer vaccines are two administrative barriers that might contribute to missed opportunities to vaccinate. Empowering nonphysician personnel to deliver vaccinations without physician involvement at the time of the visit could reduce barriers to vaccination and missed opportunities, resulting in improved vaccination delivery.

Review of evidence: effectiveness. Our search identified 16 studies regarding the effectiveness of standing orders.[36,63,72,110,118,155,162,200,217,240–246] Two additional papers provided more information regarding an already included study.[91,247] Five studies were not included in the review because of limited execution.[110,155,217,241,246] Details of the 11 qualifying studies are provided at the website: http://web.health.gov/communityguide. Qualifying studies provided data regarding six intervention arms that evaluated standing orders only and five intervention arms that evaluated multicomponent interventions that included standing orders. Multicomponent interventions included expanding access,[36,63,72,162] client reminder/recall,[36,63,72] clinic-based education,[36,118] provider education,[36,63] provider reminder/recall,[36] and assessment and feedback.

Two studies presented data that could not be expressed as a percentage point change in vaccination coverage.[162,244] Overall, eight studies of standing orders to improve vaccination coverage in adults found a median percentage point change of 28% (range, 6% to 81%). Studies in which standing orders were used alone found a median percentage point change of 51% (range, 30% to 81%). Studies in which standing orders were used as part of a multicomponent strategy found a median percentage point change of 16% (range, 6% to 26%). Most studies lasted less than a year, but one found continuing improvements over 5 years.[91] A single study in children[240] found modest declines in missed opportunities to vaccinate at non-well-child visits but no overall improvement in vaccination delivery.

Review of evidence: applicability. The body of evidence used to assess effectiveness of standing orders in adults was used to assess the applicability of these interventions to different settings, populations, and vaccines. Studies have been conducted in community[200] and other hospitals,[72,162,243] nursing homes,[245] and a variety of outpatient settings including private practices,[36] managed care organizations,[63] Veterans' Administration clinics,[72] and academic clinical organizations.[118,242,244] Studies have evaluated the effectiveness of standing orders to improve delivery of both influenza[36,63,72,118,162,200,242,244] and pneumococcal vaccinations.[118,243,245] No studies were found evaluating standing orders to improve vaccination in adolescents or to improve delivery of hepatitis B or Td vaccinations.

Review of evidence: other positive or negative effects. Other positive or negative effects were not sought in this review.

Review of evidence: economic. No economic evaluations of standing orders were identified.

Barriers to intervention implementation. Potential barriers to implementing standing orders could include: (1) difficulties encouraging effective interprofessional communication and shared responsibilities; and (2) the burden of standing orders on providers and systems. One study found that a nurse-guided algorithm to vaccinate children in a busy pediatric clinic could be completed in only 43% of eligible children.[240] Alternatively, in some settings, standing orders could reduce the burden on physicians and increase clinic efficiency.

Conclusion. According to the *Guide*'s rules of evidence, strong scientific evidence exists that standing orders are effective in improving vaccination coverage in adults. We concluded that insufficient evidence exists to assess the effectiveness of standing orders to improve vaccination coverage in children based on the following: (1) the greater complexity of vaccination protocols in children as compared with that for adults; (2) the identification of only a single qualifying study of standing orders to increase vaccination coverage in children; (3) limitations in that study's design and conduct; and (4) reported effects regarding vaccination coverage that were not substantially different from zero.

Provider Education Only

Definition. Provider education involves giving information regarding vaccinations to providers to increase their knowledge or change their attitudes. Techniques by which information is delivered can include written materials, videos, lectures, continuing medical education programs, and computerized software. Interventions that have additional features (e.g., provider reminders or assessment and feedback) or that are used in combination with other interventions (e.g., multicomponent interventions that include education) are reviewed elsewhere in this paper.

Background. Provider education is based on the assumption that provider knowledge regarding vaccination will affect physician behavior in a positive manner. Provider education could stimulate them to deliver additional vaccinations, change provider-client interactions to increase client acceptance of vaccinations, or motivate providers to implement other interventions (e.g., reminder/recall systems or standing orders).

Review of evidence: effectiveness. Our search identified six studies regarding provider education-only interventions.[200,216,248–251] An additional paper provided more information regarding an already included study.[229] Two studies had limited execution and were therefore not included in the review.[216,248] Details regarding the four qualifying studies are provided at the website: http://web.health.gov/communityguide. Two studies regarding adults evaluated vaccination coverage as an outcome. One evaluated a fact sheet attached to each client's chart and found small and nonsignificant percentage point changes and no change in provider knowledge and attitudes.[249] The other study used provider education as the comparison group in a study that evaluated provider reminders and standing orders[200] and found median percentage point changes in coverage of −30% and −7%, compared with standing orders and provider reminders, respectively.

Two studies evaluated the effectiveness of provider education regarding knowledge and attitudes.[250,251] These studies found improvements in provider knowledge and attitudes after dissemination of national guidelines for hepatitis B and implementation of an innovative problem-based learning protocol in medical schools. With one exception,[251] available studies of provider education evaluated interventions that were not very intensive. Available data cannot be generalized to more intensive efforts. Also, provider education is a part of several effective multicomponent interventions, including provider reminders, assessment and feedback, and educational interventions.

Review of evidence: other positive and negative effects. No information regarding other positive or negative effects was sought in this review.

Conclusion. According to the *Guide*'s rules of evidence, available studies provide insufficient evidence to assess the effectiveness of provider education-only interventions in improving vaccination coverage. Evidence is insufficient because of: (1) the small numbers of available studies; (2) limitations in their design and conduct; and (3) small effect sizes.

Research Issues for Provider-Based Interventions

Effectiveness

The effectiveness of recommended and strongly recommended interventions in this section (i.e., provider reminder/recall, provider assessment and feedback, and standing orders) is established. However, research issues regarding the effectiveness of these interventions remain.

- Which characteristics of provider-based interventions contribute to increased or lessened effectiveness?
- How do content and method of delivery of provider reminder/recall relate to effectiveness?
- What components of assessment and feedback interventions (e.g., incentives or benchmarking) contribute most to effectiveness?
- How do different practice settings (e.g., independent private practice settings versus hospital management organization settings) contribute to increased or lessened effectiveness of various interventions?
- What is the effectiveness of HEDIS, as a form of assessment, feedback, and benchmarking, in improving vaccination coverage? In independent private-

practice settings? In hospital management organization settings?
- What intermediate outcomes contribute to the effectiveness of provider assessment and feedback (e.g., provider's knowledge, attitudes, or behavior; additional interventions; or other factors)?
- What are the least and most effective combinations of services in multicomponent interventions?
- Can registries provide a backbone for effective interventions (e.g., provider reminder/recall)?
- How easily can systems for provider reminders or assessment and feedback that encourage the use of one clinical preventive service be adapted for other services?
- What is the relative effectiveness of provider reminders or assessment and feedback that focus on immunizations versus reminders or assessment and feedback that rotate from one clinical preventive service to another?

Because the effectiveness of provider education-only interventions has not been established, basic research questions remain.

- Are these interventions effective in improving vaccination coverage?
- Are these interventions effective in increasing provider knowledge or promoting positive provider attitudes toward vaccination?
- What attributes of provider education-only programs—medium, message, or intensity—contribute to effectiveness or lack thereof?
- Are intensive provider education programs more effective than other programs that are less intensive?

Applicability

Each recommended and strongly recommended provider-based intervention should be applicable in most relevant target populations and settings. However, possible differences in the effectiveness of each intervention for specific subgroups of the population could not be determined. Several questions regarding the applicability of these interventions in settings and populations other than those studied remain.

- Are these interventions as effective in improving vaccination coverage in adolescents as they are in children and older adults?
- Do significant differences exist regarding the effectiveness of these interventions based on the level of scale at which they are delivered (i.e., community-wide provider reminders from a registry versus managed-care-based systems versus office-practice-based systems)?

Other Positive and Negative Effects

With the exception of some discussion of improved use of other clinical and preventive care, studies included in the review did not report on other positive and negative effects of these interventions. Therefore, research regarding the following questions would be useful:

- Do provider-based interventions to increase vaccination interfere with office flow or efficiency, and if so, how can this effect be minimized?
- Do provider-based interventions result in other positive changes in use of preventive or health care as well as improving vaccination coverage?

Economic Evaluations

Generally, available economic information was sparse; therefore, considerable research is warranted regarding the following questions:

- What are the costs of these interventions?
- How do costs per additional person vaccinated compare with other interventions intended to improve vaccination coverage?
- Can strategies that are designed to improve vaccination coverage and other outcomes improve cost-effectiveness of these strategies?
- How do specific characteristics of these interventions contribute to economic efficiency?
- What particular characteristics of provider reminder/recall systems contribute most to cost-effectiveness?
- What combinations of components in multicomponent interventions are most cost-effective?
- How do the opportunity costs of multicomponent versus single-component interventions compare?
- What is the cost-benefit or cost-utility of these interventions?

Barriers

- How can these interventions be implemented with minimal administrative burden placed on providers or systems?
- Do community-wide registries reduce barriers to use or increase use of provider reminders, provider assessment and feedback, or provider education?
- For provider reminder/recall and provider assessment and feedback, how can the burden on providers (e.g., data entry) be reduced?
- Can improved sampling strategies be developed and can meaningful information be extracted from small samples of records?
- How can the uptake of these interventions in private practices be encouraged?

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Appendix A
Methods

In the *Guide to Community Preventive Services; Systematic Reviews and Evidence-Based Recommendations*, evidence is summarized regarding: (1) the effectiveness of interventions; (2) the applicability of effectiveness data (i.e., the extent to which available effectiveness data might apply to other populations and settings); (3) other positive or negative effects of the intervention, including positive or negative health and nonhealth outcomes; (4) economic impact; and (5) barriers to implementation of interventions. The process that was used to systematically review evidence and then translate that evidence into conclusions made in this paper involved:

- forming an evidence review and *Guide* chapter development team;
- developing a conceptual approach to organizing, grouping, and selecting interventions;
- selecting interventions to evaluate;
- searching for and retrieving evidence;
- assessing the quality and summarizing the body of evidence of effectiveness;
- translating the body of evidence of effectiveness into conclusions;
- considering data regarding applicability, other effects, economic impact, and barriers to implementation; and
- identifying and summarizing research gaps.

This appendix summarizes how these methods were used in developing the vaccine-preventable disease evidence reviews. The *Guide*'s methods for systematic reviews and linking evidence to recommendations are explained in detail elsewhere (see Briss PA, et al. "Developing an Evidence-Based *Guide to Community Preventive Services*" pp. 35–43 in this issue). The vaccine-preventable disease intervention reviews were developed by a multidisciplinary team representing a variety of perspectives (see authorship and acknowledgment lists). The conceptual approach for the vaccine-preventable disease evidence reviews is described in the second section of the body of the text.

Search for Evidence

Electronic searches for literature were conducted of MEDLINE, Embase, Psychlit, CAB Health, and Sociological Abstracts. The team also reviewed reference lists in articles and consulted with immunization experts. To be included in the review, a study had to:

- have a publication date of 1980–1997;
- address universally recommended adult, adolescent, or childhood vaccinations;
- be a primary study rather than, for example, a guideline or review;
- take place in an industrialized country or countries;
- be written in English;
- meet the evidence review and *Guide* chapter development team's definition of the interventions; provide information on one or more outcomes related to the analytic frameworks; and
- compare a group of persons who had been exposed to the intervention with a group who had not been exposed or who had been less exposed. In addition, we excluded studies with least suitable designs for two interventions (provider reminder/recall and client reminder/recall) where the literature was most extensive (see Briss PA, et al. pp. 92–96 in this issue for a description of the study designs included and their definitions).

Studies were also reviewed that did not meet these criteria but had been recommended by one or more experts as having potential to change a preliminary assessment of effectiveness. For example, unpublished studies of interventions involving the Special Supplemental Nutrition Program for Women, Infants, and Children and 1998 publications on home visits were reviewed.

Assessing the Quality and Summarizing the Body of Evidence of Effectiveness

Each study meeting the inclusion criteria was read by two reviewers who used a standardized abstraction form to record information from the study. Any disagreements between two reviewers were reconciled by consensus among the development team members.

Quality of study execution was systematically assessed (see Briss PA, et. al. pp. 35–43 in this issue). For this review we used a slightly earlier version of the data abstraction form (see Zaza S, et al. "Data Collection Instrument and Procedure for Systematic Reviews in the *Guide to Community Preventive Services*," pp. 44–74 in this issue) that organized potential limitations in execution into the following eight categories:

- definition and selection of study and comparison population(s);
- definition and measurement of exposure and intervention;
- assessment of outcomes;
- follow-up and completion rates;
- bias;
- data analysis;
- confounding; and
- miscellaneous criteria (e.g., lack of statistical power).

Execution of each study was characterized as good, fair, or limited based on the total number of categories with limitations. Good studies had zero or one limitation; fair studies, two to four; and limited studies, five or more. Studies with limited execution did not qualify for the review.

We abstracted information from the studies regarding one or more outcomes of interest:

- measures of vaccination (i.e., vaccination coverage or doses delivered);
- disease outcomes, when available; and
- other outcomes (e.g., knowledge or attitudes for educational interventions), if available and relevant.

In general, we reported data regarding disease outcomes and other nonvaccination outcomes (e.g., knowledge and attitudes) as they were reported by the authors, without attempting to transform these measures. We then summarized them qualitatively.

Where possible, we represented results of each study as point estimates for change in vaccination coverage attributable to the interventions. We then calculated percentage point changes and baselines using the following formula:

- For studies with before/after measurements and concurrent comparison groups:

$$(Ipost - Ipre) - (Cpost - Cpre); \text{ baseline} = Ipre$$

For studies with post-only coverage measurements and concurrent comparison groups:

$$Ipost - Cpost; \text{ baseline} = Cpost$$

For studies with before/after measurements but no concurrent comparison:

$$Ipost - Ipre; \text{ baseline} = Ipre, \text{ where}$$

Ipost = last reported coverage in the intervention group after the intervention.
Ipre = reported coverage in the intervention group immediately before the intervention.
Cpost = last reported coverage in the comparison group after the intervention. And,
Cpre = reported coverage in the comparison group immediately before the intervention.

In the studies, vaccination coverages could have been measured as series-complete (i.e., proportion of persons up-to-date with each of several vaccinations) or as one or more individual vaccinations. When a study presented more than one vaccination result (but not a series-complete measure), we used an equally weighted average of percentage point changes. Studies without coverage outcomes, or for which percentage point changes were not calculable, were not included in descriptive statistics or in figures; however, these studies are described in the text.

We often had to select among several possible effect measures. When available, we used measures adjusted for potential confounders in multivariate analyses in preference to crude effect measures. In children, we used outcome measures among children closest to age 2 years. In studies that made comparisons between multiple groups, we compared each intervention group with the group that received no intervention or the least intensive intervention. We included separate effect measures where possible for children, adolescents, and adults, but did not otherwise report different effect measures for different subpopulations.

To summarize the findings regarding the effectiveness of an intervention across multiple studies, we displayed results of individual studies in tables and figures and reported median and range of effect measures. We summarized the strength of the body of evidence based on numbers of available studies, strength of their design and execution, and size and consistency of reported effects.

Other Effects

Guide reviews routinely seek information on other effects (i.e., positive and negative health or nonhealth "side effects"). We sought evidence of potential harms of these population-based interventions if they were mentioned in the effectiveness literature or thought to be of importance by the evidence review team. For example, we sought evidence of dropout from WIC programs, which has been suggested as a potential effect of WIC interventions.

Although vaccines are generally safe and effective, none is 100% safe or effective. Universally recommended vaccines have been documented in other reviews to have benefits for individuals that outweigh the risk of serious health effects. Therefore, this review did not evaluate possible positive or negative effects of the vaccines themselves.

Economic Evaluations

Review of economic evaluation studies was performed if the intervention was effective (see Carande-Kulis VG, et al. "Methods for Systematic Reviews of Economic Data for the *Guide to Community Preventive Services*," pp. 75–91 in this issue). To be included in the reviews, a study had to:

- use an economic analytical method (e.g., cost analysis, cost-effectiveness analysis, cost-benefit analysis, or cost-utility analysis);
- have a publication date of 1980–1998;
- address universally recommended adult, adolescent, or childhood vaccinations;
- be a primary study rather than, for example, a guideline or review;
- be performed in the Established Market Economies as described by the World Bank[1];
- be written in English;
- meet the evidence review and *Guide* chapter development team's definition of one or more interventions;
- provide an economic evaluation of an intervention as described in the evidence reviews rather than economic evaluation of a vaccine; and

- report sufficient information so that an adjusted estimate of cost, cost-effectiveness, cost-utility, or cost-benefit could be made.

A standardized abstraction form (see Carande-Kulis VG, et al., pp. 75–91 in this issue) was used for abstracting and adjusting data to meet the reference case suggested by the panel on cost-effectiveness in health and medicine.[2] Using the abstraction form, costs were adjusted to 1997 U.S. dollars. The cost-effectiveness ratio was defined, for the vaccine-preventable disease evidence reviews, as the cost of the program per additional vaccination or cost per fully vaccinated child. Average cost was defined as cost of the program per person or vaccination. Where possible, cost of vaccinations were excluded to avoid overestimating costs of the intervention themselves. Ratios and averages ≤10 were cited with two decimal points. Ratios and averages ≥11 were rounded to the nearest integer. For interventions with four or more cost-effectiveness ratios, ratio distribution was described by the median and range (Appendix C).

Summarizing Barriers to Implementation of Interventions

Information regarding barriers to implementation of the interventions are described in the main text. Information on barriers did not affect Task Force recommendations.

Summarizing Research Gaps

Systematic reviews in the *Guide* identify existing information on which to base public health conclusions. An important additional benefit of these reviews is identification of areas where information is lacking or of poor quality. However, the reader should note that many major areas of vaccine-preventable disease research (e.g., epidemiology of vaccine-preventable diseases, clinical and laboratory features of vaccine-preventable diseases, and vaccine development and efficacy) and some areas of intervention research were not reviewed and are thus not represented in the sections on research gaps. To develop these sections, we used the following process:

- We identified remaining research questions for each intervention evaluated.
- In cases of interventions for which evidence of effectiveness was sufficient or strong, we summarized remaining questions regarding effectiveness, applicability, other effects, economic consequences, and barriers.
- In cases of interventions for which evidence of effectiveness was insufficient, we summarized remaining questions regarding effectiveness and other effects. We summarized applicability issues only if they affected the assessment of effectiveness. We decided that identifying research gaps in barriers or economic evaluation before effectiveness was demonstrated would be premature.
- For each category of evidence, we identified issues that had emerged from the review, based on the informed judgement of the evidence review team. Several factors influenced that judgement.

General

- We avoided addressing downstream issues if we could not address upstream issues. For example, if no study had answered whether the intervention was effective, we did not ask what might increase effectiveness. Similarly, if cost-effectiveness data were unavailable, we did not ask how efficiency might be improved.
- If no information or inadequate information existed to draw a conclusion regarding effectiveness, applicability, other effects, or economic evaluations, we listed these as evidence gaps.
- When a conclusion was drawn regarding evidence, we applied team judgement regarding whether additional issues remained.

Effectiveness

- We did not necessarily identify studies that would simply change a body of evidence from sufficient to strong as evidence gaps.
- If effectiveness was demonstrated using some but not all outcomes, we did not necessarily list all other possible outcomes as evidence gaps.

Applicability

- If available evidence was thought to generalize, we did not necessarily identify all subpopulations or settings where studies had not been done as evidence gaps.

Following the reviews of individual interventions, we considered whether overriding methodologic issues existed.

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Appendix B

Studies of the Effectiveness of Client Reminder/Recall

Author, Reference Number, Study Period	Design, Category, Execution	Study Location, Setting Type, Population Description	Interventions Studied, Comparisons, (Number of Participants)	Outcomes and Effect Measures, Including Percentage Point Change Unless Otherwise Noted (Statistical Significance)
			Effects of Client Reminders/Recall Only	
Alemi Ref. 1 1993–94	Nonrandomized trial, greatest suitability, fair	Cleveland, Ohio; clinics/offices; clients — aged <6 months; urban; 81%–88% black; low socioeconomic status	1. Computer-generated client telephone reminders and recalls *versus* 2. Comparison group of usual care (Total study population, 213 participants)	Up-to-date with DTP/OPV/MMR/Hib vaccinations, 1 *versus* 2 = 25% change ($p < 0.005$)
Alto Ref. 2 1991	Randomized trial, greatest suitability, fair	Colorado; family practice residency clinic; clients — aged >2 months and <7 years; 17% Hispanic; urban; 51% male; low socioeconomic status	1. Mailed and telephone client reminders *versus* 2. Comparison group of usual care (Total study population, 464 participants before randomization)	Up-to-date with DTP/OPV/MMR/Hib vaccinations, 1 *versus* 2 = 8% change ($p < 0.011$)
Barnas Ref. 3 Time not reported	Randomized trial, greatest suitability, fair	Milwaukee, Wisconsin; primary-care clinic; clients — aged ≥65 years; mean 74 years; urban/suburban; 51% black; 70% female	1. Mailed client reminder for influenza *plus* reminders to attend clinic *versus* 2. Comparison group receiving reminder to attend clinic (Total study population, 804 participants)	Influenza, 1 *versus* 2 = −7% change ($p < 0.04$)
Brimberry Ref. 4 1984–85	Randomized trial, greatest suitability, fair	Little Rock, Arkansas; family practice residency clinic; clients — adults; urban/suburban/rural; otherwise, not well-described	1. Mailed client reminder *versus* 2. Telephone client reminder *versus* 3. Comparison group of usual care (Total study population, 787 participants)	Influenza, 1 *versus* 3 = 5.9% change ($p < 0.02$); 2 *versus* 3 = 5.5% change ($p < 0.02$); no difference between mail and telephone reminders
Buchner Ref. 5 1984	Randomized trial, greatest suitability, fair	Seattle, Washington; private practice offices; clients — aged ≥65 years; mean 76 years; suburban/rural; 66% female; low/middle socioeconomic status	1. Mailed client remainder *versus* 2. Comparison group of usual care (Total study population, 540 analyzed)	Influenza, 1 *versus* 2 = 1% change (nonsignificant)
Campbell Ref. 6 Time not reported	Randomized trial, greatest suitability, good	Rochester, New York; pediatric community clinic at Strong Memorial Hospital; clients — aged birth–13 months; urban; 49%–55% female; 60%–67% black; low socioeconomic status	1. Mailed letter reminders for well child care (87 participants) *versus* 2. Mailed postcard reminders (96) *versus* 3. Comparison group of usual care (105)	DTP by age 7 months, 1 *versus* 3 = 6% change; 2 *versus* 3 = 2% change ($p = 0.72$ for differences between the three groups)

Table B-1 Continued

Author, Reference Number, Study Period	Design, Category, Execution	Study Location, Setting Type, Population Description	Interventions Studied, Comparisons, (Number of Participants)	Outcomes and Effect Measures, Including Percentage Point Change Unless Otherwise Noted (Statistical Significance)
Carter Ref. 7 Time not reported	Randomized trial, greatest suitability, fair	Seattle, Washington; ambulatory clinic at VA hospital; clients — adults; urban; not vaccinated in the year before the intervention	1. Standard client reminder letter *plus* brochure (66 participants) *versus* 2. Augmented client reminder letter *plus* brochure (55) *versus* 3. Augmented client reminder letter (57) 4. Comparison group of standard client reminder letter (57)	Influenza, 1 *versus* 4 = 13% change ($p < 0.05$); 2 *versus* 4 = 23% ($p < .05$), 3 *versus* 4 = 7% (nonsignificant); influenza, combined 1 and 2 *versus* 3 and 4 = 13% ($p < 0.025$)
CDC Ref. 8 1994	Group randomized trial, greatest suitability, fair	Montana and Wyoming; communitywide; clients — aged ≥ 65 years; mostly rural	1. Mailed "personal letter" reminders (87 participants) *versus* 2. Mailed brochure reminders (96) *versus* 3. Comparison group of usual care (105) All groups received public service announcements and provider reminders	Influenza, 1 and 2 combined *versus* 3 = 6.1% (CI = 5.5%–6.7%)
Grabenstein Ref. 9 1993	Randomized trial, greatest suitability, good	Durham County, North Carolina; community pharmacies; clients — mean age 67 years; 62% female, 79% white, socioeconomic status mid/high	1. Mailed letter on pharmacy stationary relating risk and availability of vaccination (242 participants) *versus* 2. Mailed letter regarding "poison proofing" home (240) Both groups received reminder letter 2–3 weeks later	Influenza, 1 *versus* 2 = 10% (CI = 1%–19%)
Larson Ref. 10 1978–79	Randomized trial, greatest suitability, fair	Seattle, Washington; University of Washington Family Medicine Center; clients — mean age 67 years; 68% female	1. Neutral card stating availability of vaccinations *versus* 2. Health belief model card *versus* 3. Personal card signed by physician *versus* 4. Comparison group of usual care (Total study population, 283 participants)	Influenza, 1 *versus* 4 = 5% change; 2 *versus* 4 = 31% ($p < 0.001$); 3 *versus* 4 = 21% ($p < 0.025$); 2 *versus* 1 = 26% ($p < 0.01$); 3 *versus* 1 = 16% ($p < 0.1$)
Lieu Ref. 11 1994–95	Randomized trial, greatest suitability, fair	Northern California; managed care organization; clients — aged 20–24 months; middle/upper socioeconomic status	1. Computer-generated personalized letter client recalls (172 participants) *versus* 2. Comparison group of usual care (149)	MMR by age 24 months, 1 *versus* 2 = 1.7% change ($p < 0.001$)

Table B-1 Continued

Author, Reference Number, Study Period	Design, Category, Execution	Study Location, Setting Type, Population Description	Interventions Studied, Comparisons, (Number of Participants)	Outcomes and Effect Measures, Including Percentage Point Change Unless Otherwise Noted (Statistical Significance)
McDowell Ref. 12 Rosser Ref. 13 1983–85	Group randomized trial (by family), greatest suitability, fair	Ottawa, Canada; University of Ottawa Family Medicine Center at Civic Hospital; providers, staff and resident physicians, nurses; clients — aged >65 years for influenza and > 20 years for tetanus	1. Computer-generated provider reminder (218 participants) *versus* 2. Client reminder by telephone (226) *versus* 3. Client reminder by letter (231) *versus* 4. Comparison group of randomized controls (230)	Influenza, 1 *versus* 4 = 13% change ($p < 0.005$); 2 *versus* 4 = 26% ($p < 0.005$); 3 *versus* 4 = 26% ($p < 0.005$) ; Td, 1 *versus* 4 = 20% (CI = 17%–22%); 2 *versus* 4 = 21% (CI = 18%–24%); 3 *versus* 4 = 27% (CI = 25%–31%)
Moran Ref. 14 Time not reported	Randomized trial, greatest suitability, fair	North Carolina ambulatory general internal medicine and gerontology clinic; clients — mean age 76 years; 65% female	1. Client reminded with brochure (450 participants) *versus* 2. Comparison group of usual care (450)	Influenza, 1 *versus* 2 = 1% change ($p > 0.5$)
Mullooly Ref. 15 1984–85	Nonrandomized trial, greatest suitability, fair	Portland, Oregon; managed care organization; clients — aged >65 years; 47%–52% female	1. "Personalized" client reminder letter (1,105 participants) *versus* 2. Comparison group of usual care (1,152)	Influenza, 1 *versus* 2 = 9% change (CI = 5%–13%); adjustment for the excess of males in the intervention group moderated the change to 8%
Siebers Ref. 16 1982–83	Randomized trial, greatest suitability, fair	Madison, Wisconsin; general internal medicine clinic, University of Wisconsin hospital; clients — aged ≥65 years; otherwise, target population not described	1. Client reminder letter (173 participants) *versus* 2. Comparison group of usual care (92)	Pneumococcal, 1 *versus* 2 = 13% change (significant)
Spaulding Ref. 17 1983–84	Randomized trial, greatest suitability, fair	Fort Lewis, Washington; military-affiliated family practice department; clients — aged birth–>64 years; 43%–50% female	1. Client reminder postcard (519 participants) *versus* 2. Comparison group of usual care (545) All clients received enhanced clinic access and free vaccination	Influenza, 1 *versus* 2 = 27% change ($p < 0.001$) for those aged >65 years; influenza, 1 *versus* 2 = 16% ($p < 0.001$) for all ages
Stehr-Green Ref. 18 Time not reported	Randomized trial, greatest suitability, fair	Atlanta, Georgia; public health clinics; clients — aged <2 years, average 8.7–9.2 months	1. Computer-generated telephone reminder (101 participants) *versus* 2. Comparison group of usual care (36)	DTP, 1 *versus* 2 = 3% change (nonsignificant)
Tollestrup Ref. 19 1987	Nonrandomized trial; greatest suitability, fair	Everett and Snohomish Counties, Washington; county health department clinic; clients — aged <5 years	1. Client recall letter if 1 month overdue (182 participants) *versus* 2. Comparison group of usual care (211)	DTP vaccination within 5 months, 1 *versus* 2 = 18% change ($p < 0.01$)

Table B-1 continued

Author, Reference Number, Study Period	Design, Category, Execution	Study Location, Setting Type, Population Description	Interventions Studied, Comparisons, (Number of Participants)	Outcomes and Effect Measures, Including Percentage Point Change Unless Otherwise Noted (Statistical Significance)
Tucker Ref. 20 1980–83	Time-series, moderate suitability, fair	Syracuse, New York; family practice residency model office; faculty private office; clients — aged ≥65 years; otherwise, not well-described	1. Mailed client reminder letter from residency director (856 clients of model office) *versus* 2. Same but stronger wording and signed by client's physician (1251 clients of model office, 249 clients of private office) *versus* 3. Prior usual care (75 clients of model office, 75 clients of private office)	Model office — Influenza, 1 *versus* 3 = 7% change (nonsignificant); 2 *versus* 3 = 7% (nonsignificant); private office — influenza, 2 *versus* 3 = 7% (nonsignificant)
Effects of Client Reminder/Recall in Combination with Other Interventions				
Barton Ref. 21 1983–87	Time-series, moderate suitability, fair	Boston, Massachusetts; clinic/provider's offices; clients — aged >65 years; urban	1. Client reminders *plus* client education *plus* provider reminders *versus* 2. Same *plus* feedback to individual physicians *versus* 3. Previous usual care (Total study population, 647 participants)	Influenza, 1 *versus* 3 = 18% change; 2 *versus* 3 = 36% (statistical significance not reported)
Becker Ref. 22 1986–87	Randomized trial, greatest suitability, fair	Charlottesville, Virginia; University of Virginia medicine clinic; providers: residents; clients — aged 40–60 years; mean 51–52; 64%–72% female; 50%–60% black; low socioeconomic status	1. Physician and client reminders (168 participants) *versus* 2. Physician reminders (203) *versus* 3. Comparison group (192)	Influenza, pneumococcal, and Td, 2 *versus* 3 = 9%, 2%, and 6% change; 1 *versus* 3 = 16%, 1%, 8% (analysis of variance for groups 1, 2, and 3 only significant for Td)
Browngoehl Ref. 23 Kennedy Ref. 24 1992–93	Retrospective cohort study; moderate suitability; fair	Philadelphia, Pennsylvania; Medicaid managed care group; clients — aged 30–35 months (control group) and 18–24 months (study group); low socioeconomic status	1. Tracking and reminders *plus* provider education and incentives *plus* parent education and incentives *plus* transportation assistance *plus* home visits (1,254 participants) *versus* 2. Control group of older children (1,257)	4 DTP/3 OPV/1 MMR at age 35 months, 1 *versus* 2 = 7% change ($p < 0.05$); 4 DTP/3 OPV/1 MMR/1 Hib at age 35 months, 1 *versus* 2 = 2% change (nonsignificant) Higher coverage in children who received home visits (significance not given)
Buffington Ref. 25 1989	Randomized trial, greatest suitability, fair	Rochester, New York; private physician offices; clients — aged ≥65 years; urban/suburban; otherwise, target population not well-described	1. Provider feedback *versus* 2. Provider feedback *plus* mailed client reminders *versus* 3. Comparison group of usual care (Total study population, 10,525 participants)	Influenza, 1 *versus* 3 = 16% change ($p < 0.001$); 2 *versus* 3 = 17% ($p < 0.001$)

Table B-1 Continued

Author, Reference Number, Study Period	Design, Category, Execution	Study Location, Setting Type, Population Description	Interventions Studied, Comparisons, (Number of Participants)	Outcomes and Effect Measures, Including Percentage Point Change Unless Otherwise Noted (Statistical Significance)
Frame Ref. 26 1991–92	Group randomized trial, greatest suitability, fair	Dansville, New York; family practice offices; providers — family physicians and physician's assistants; clients — aged ≥21 years; rural; low/middle socioeconomic status	1. Computer-based telephone client reminders *plus* provider reminders on chart (829 participants) *versus* 2. Comparison group of client reminders triggered by physician request (836)	Td, 1 *versus* 2 = 21% change (CI = 16%–26%); change for all preventive care was 11%
Hutchison Ref. 27 Frank Ref. 28 1981–87	Time-series study, moderate suitability, fair	Hamilton, Ontario; community clinic; clients — aged >65 years; urban; 68% female	1. Mailed client reminder letter (273 participants) and associated drop-in clinics *versus* 2. Prior usual care	Influenza, 1 *versus* 2 after 6 years = 35% change (statistical testing not reported)
Karuza Ref. 29 1990–92 Calkins Ref. 30 1991–92	Group randomized trial, both greatest suitability, good and fair, respectively	Buffalo, New York; private practices; providers — 33% family practice and 67% internal medicine; clients — adults; urban; 80% male	1. Provider feedback *plus* one or more of provider reminders on chart *and/or* client reminders *and/or* waiting room posters *and/or* provider education *and/or* standing orders *and/or* special appointments *versus* 2. Comparison group underwent similar process for nonsteroidal drug prescribing (51 physicians)	Influenza, 1 *versus* 2 = 16% change ($p < 0.01$); no change in pre/post knowledge or attitudes
Lukasik Ref. 31 1985	Nonrandomized trial, greatest suitability, fair	London, Ontario; Victoria Family Medicine Center; clients — aged ≥65 years; otherwise, not well-described	1. Provider reminders on chart *plus* client education *plus* waiting room poster *plus* client reminders *plus* increased access (120 participants) *versus* 2. Provider reminders on chart *plus* client education *plus* poster (123) *versus* 3. Previous usual care	Influenza, 1 *versus* 2 = 22% change ($p = 0.002$); 1 *versus* 3 = 44%; 2 *versus* 3 = 22%
Margolis Ref. 32 1989–90	Nonrandomized trial, greatest suitability, fair	Urban/suburban Minneapolis-St. Paul, Minnesota; staff model health maintenance organization; clients — aged ≥65 years	1. Standing orders, client reminder/recall, provider education, expanded access *versus* 2. Usual care Two clinics in each group; outcomes assessed in 150 randomly chosen clients/clinic	Influenza, intervention clinic 1 *versus* comparison clinic 1 = -8% change; intervention clinic 2 *versus* comparison clinic 2 = 20%; post- *versus* prechange in intervention clinic 2 (significant, $p = 0.01$); changes in other clinics nonsignificant
Moran Ref. 33 1990	Randomized trial, greatest suitability, fair	Location not reported; community health center; clients — adults; urban; 61% female	1. Single client reminder letter (135 participants) *versus* 2. Two client reminder letters (138) *versus* 3. Comparison group of usual care (136) Vaccination available free and without appointment	Influenza, 1 *versus* 3 = 2% change (nonsignificant); 2 *versus* 3 = -8% (nonsignificant)

Table B-1 continued

Author, Reference Number, Study Period	Design, Category, Execution	Study Location, Setting Type, Population Description	Interventions Studied, Comparisons, (Number of Participants)	Outcomes and Effect Measures, Including Percentage Point Change Unless Otherwise Noted (Statistical Significance)
Nichol Ref. 34 1987 Nichol Ref. 35 1987–92	Other designs with concurrent comparison groups, greatest suitability, time-series study, moderate suitability, both fair	Minneapolis, Minnesota, *versus* other midwestern cities; VA outpatient services; clients — veterans	1. Standing orders, walk-in "flu-shot" clinics, vaccination stations in busy clinic areas, mailing to all outpatients (378 participants) *versus* 2. Usual care at 3 other midwestern academic hospitals (997)	Influenza, 1 *versus* 2 = 26% change ($p < 0.00001$); time-series data found that coverage rates continued to increase for 5 years; additional 15% among all clients ($p < 0.0001$)
O'Sullivan Ref. 36 Time not reported	Randomized trial, greatest suitability, fair	Eastern United States; large urban teaching hospital; clients — maternal aged ≤17; 100% black; low socioeconomic status	1. Education and rigorous follow-up relating to family planning, parenting behaviors, return to school, health education, recall phone calls/letters, client-held vaccination records, lower costs *versus* 2. Usual care	Children aged 18 months, 1 *versus* 2 = 15% change in up-to-date vaccination coverage ($p < 0.02$); mothers, clinic attendance and repeat pregnancy rates better in intervention group; return to school and emergency room use did not differ
Oeffinger Ref. 37 Time not reported	Nonrandomized trial, greatest suitability, fair	McLennan County, Texas; family practice residency program in hospital and clinic; clients — aged <1 year with 35%–39% adolescent mothers; 28%–36% Hispanic; 33%–47% black	1. Client education at clinic *plus* client reminder letter (nonspecific) 2 months after birth *versus* 2. Comparison group of usual care	Up-to-date with 3 DTP vaccination/2 OPV by 12 months, 1 *versus* 2 = −4% ($p = 0.41$)
Ohmit Ref. 38 1989–92	Time-series study, moderate suitability, fair	Seven counties in southwest Michigan; clients — aged ≥65 years; otherwise, not described	1. Communitywide education of physicians and clients *plus* free vaccination *plus* provider education *plus* client education *plus* mailed postcard client reminders *plus* outreach in senior centers (evaluated in 1,315 and 1,663 participants in 1990–91 and 1991–92, respectively) *versus* 2. Prior usual care (client numbers not given)	Influenza, 1 *versus* 2 = 16% change (statistical significance not reported)
Paunio Ref. 39 1982–86	Time-series study, moderate suitability, fair	Finland; communitywide; target population — aged birth–11 years	1. Registry *plus* mass-media reporting of local data regarding vaccination coverage *plus* provider reminders *plus* parent reminders *versus* 2. Usual care before registry	MMR, 1 *versus* 2 = 8% change (no significance testing) Fitted weekly time-series models of number of MMR delivered 1 *versus* 2, no effect on number of vaccinations administered to children aged 14–18 months; mass-media might have increased vaccinations administered to children aged 6 years; all three interventions increased numbers of children aged 6 years who received first MMR

Table B-1 Continued

Author, Reference Number, Study Period	Design, Category, Execution	Study Location, Setting Type, Population Description	Interventions Studied, Comparisons, (Number of Participants)	Outcomes and Effect Measures, Including Percentage Point Change Unless Otherwise Noted (Statistical Significance)
Pierce Ref. 40 1989 (pre) 1993 (post)	Nonrandomized trial, greatest suitability, fair	Albuquerque, New Mexico; public health clinics; aged ≤12 months; 29%–70% Hispanic; most of remainder, white; 34% below poverty level	1. Implementation of "Standards for Pediatric Vaccination Practices;" including evening and Saturday clinic hours *plus* client and provider education *plus* client reminders *plus* community involvement and outreach (846 participants pre, 309 post) *versus* 2. Usual care (753 pre, 138 post)	Dropout, late start, and missed opportunities declined at intervention site relative to comparison; 3 DTP/2 OPV, 1 *versus* 2 = 17% increase at 7 months and 24% at 12 months (significance not tested because whole population included)
Soljak Ref. 41 1985	Before/after study for provider reminders; least-suitable, fair; nonrandomized trial for client reminders, greatest suitability, fair	Northland, New Zealand; clinics, offices; clients — children; otherwise, not well-described	1. Provider reminders by mail *versus* 2. Provider reminders by mail *plus* client reminders *versus* 3. Prior usual care (Size of target population not found)	Up-to-date with "all appropriate antigens" 1 *versus* 2 = "no significant difference"; 1 and 2 combined *versus* 3 = 5% at 5 months (risk ratio significant)
Waterman Ref. 42 1992–94	Nonrandomized trial, greatest suitability, fair	San Diego County, California; clients — children aged 2–4 years; 87% Hispanic; low socioeconomic status	1. Free walk-in vaccination clinics *plus* client reminders *plus* provider education *plus* multiple education and health promotion strategies *plus* assessment referral and education of WIC clients *versus* 2. Comparison community of usual care	DTP/OPV/MMR (4:3:1 doses, respectively), 1 *versus* 2 = 12% (statistical significance not found)
		Effects of Client Reminder/Recall Only and in Combination with Other Interventions		
Moran Ref. 43 1991	Randomized trial, greatest suitability, fair	Boston, Massachusetts; community health center clinics; clients — adults, mean age 66 years; urban; 33%–35% male; low socioeconomic status	1. Mailed client reminders *versus* 2. Lottery-type client incentive *versus* 3. Both *versus* 4. Comparison group of usual care (Total study population, 797 participants) All groups received walk-in vaccinations, free vaccinations, and health fair	Influenza, 1 *versus* 4 = 16% change; 2 *versus* 4 = 9%; 3 *versus* 4 = 6%; multivariate analysis odds ratios, 1 = 2.29% (CI = 1.45%–3.61%); 2 = 1.68% (CI = 1.05%–2.68%), 3 = 1.41% (CI = 0.88%–2.27%)
Nexøe Ref. 44 1995	Randomized trial, greatest suitability, fair	Denmark; general practices; clients — adults ≥65 years; 60% female	1. Mailed client reminders (195 participants) *versus* 2. Mailed client reminder *plus* free vaccination (195) *versus* 3. Comparison group of usual care (195)	Influenza, 1 *versus* 3 = 24% change; 2 *versus* 3 = 47% (no statistical tests for these comparisons)

Table B-1 Continued

Author, Reference Number, Study Period	Design, Category, Execution	Study Location, Setting Type, Population Description	Interventions Studied, Comparisons, (Number of Participants)	Outcomes and Effect Measures, Including Percentage Point Change Unless Otherwise Noted (Statistical Significance)
Ornstein Ref. 45 1988–89	Group randomized trial (by practice group), greatest suitability, fair	South Carolina; family medicine center at University of South Carolina; providers — faculty, residents, and fellows in family medicine; clients aged >18 years, mean age 40 years; urban; 61% female; 61% black; low socioeconomic status	1. Computerized physician reminders on chart (1,988 participants) *versus* 2. Client reminders (1,925) *versus* 3. Physician and client reminders (1,908) *versus* 4. Comparison group of usual care (1,576)	Td, 1 *versus* 4 = 6.7% change; 2 *versus* 4 = 5.7%; 3 *versus* 4 = 8.2%; significant improvements in 3 of 4 other preventive services
Satterthwaite Ref. 46 Time not reported	Randomized trial, greatest suitability, fair	Aukland, New Zealand; general practices; clients — aged >65 years; otherwise, target population not described	1. "Personal" client reminder letter (931 participants) *versus* 2. Same *plus* free vaccination offered in letter (930) *versus* 3. Comparison group of usual care (930)	Influenza, 1 *versus* 3 = 10% change ($p < 0.001$); 2 *versus* 3 = 28% ($p < 0.001$)
Yokley Ref. 47 Time not reported	Group randomized trial by family, greatest suitability, fair	Akron, Ohio; public health clinic; clients aged ≤5 years, mean 37 months; 50% female; 64% white	1. Mailed general client reminder (195 participants) *versus* 2. Mailed specific client reminder (190) *versus* 3. Mailed specific client reminder *plus* special off hours clinics (185) *versus* 4. Mailed specific client reminder *plus* parent incentive lottery (183) *versus* 5. Comparison group of usual care (191)	Vaccinated with at least 1 antigen after 3 months, 1 *versus* 5 = 3% change (not significant); 2 *versus* 5 = 13% (not significant); 3 *versus* 5 = 16% (significant); 4 *versus* 5 = 18% (significant)

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Studies of the Effectiveness of Client or Family Incentives

Author, Reference Number, Study Period	Design, Category, Execution	Study Location, Setting Type, Population Description	Interventions Studied, Comparisons, (Number of Participants)	Outcomes and Effect Measures, Including Percentage Point Change Unless Otherwise Noted (Statistical Significance)
Browngoehl Ref. 1 Kennedy Ref. 2 1992–93	Retrospective cohort study; moderate suitability; fair	Philadelphia, Pennsylvania; Medicaid managed care group; clients — children aged 30–35 months (control group) and 18–24 months (study group); low socioeconomic status	1. Tracking and reminders *plus* provider education and incentives *plus* parent education and incentives *plus* transportation assistance *plus* home visits (1,254 participants) *versus* 2. Control group of older children (1,257)	4 DTP/3 OPV/1 MMR at age 35 months, 1 *versus* 2 = 7% change ($p < 0.05$); 4 DTP/3 OPV/1 MMR/1 Hib at age 35 months, 1 *versus* 2 = 2% change (nonsignificant) Higher coverage in children who received home visits (significance not given)
Moran Ref. 3 1991	Randomized trial, greatest suitability, fair	Boston, Massachusetts; community health center; clients — adults, mean age 66 years; urban; 33%–35% male; low socioeconomic status	1. Mailed client reminders *versus* 2. Lottery-type client incentive *versus* 3. Both *versus* 4. Comparison group of usual care (Total study population, 797 participants) All groups received walk-in vaccinations, free vaccinations, and health fair	Influenza, 1 *versus* 4 = 16% change; 2 *versus* 4 = 9%; 3 *versus* 4 = 6%; multivariate analysis odds ratios, 1 = 2.29% (CI = 1.45%–3.61%, 2 = 1.68% (CI = 1.05%–2.68%, 3 = 1.41% (CI = 0.88%–2.27%)
Yokley Ref. 4 Time not reported	Group randomized trial (by family), greatest suitability; fair	Akron, Ohio; public health clinic; clients — aged ≤5 years, mean 37 months; 50% female; 64% white	1. Mailed general client reminder (195 participants) *versus* 2. Mailed specific client reminder (190) *versus* 3. Mailed specific client reminder *plus* special off hours clinics (185) *versus* 4. Mailed specific client reminder *plus* parent incentive lottery (183) *versus* 5. Comparison group of usual care (191)	Vaccinated with at least 1 antigen after 3 months, 1 *versus* 5 = 3% change (nonsignificant); 2 *versus* 5 = 13% (nonsignificant); 3 *versus* 5 = 16% (significant); 4 *versus* 5 = 18% (significant)

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Appendix C

Economic Evaluations of Client Reminder/Recall

Author, Reference Number, Study Period	Analytic Method, Reported or Calculated Summary Measure	Study Location, Setting Type, Population Description, Vaccine	Interventions Studied, Comparisons	Base Year, Costs Included, Reported Summary Measure, Coverage Baseline and Increase	Adjusted Base Year, Summary Measure Adjusted Value, Notes
Buchner Ref. 1 1984	Cost-effectiveness; cost-effectiveness ratio in dollars per additional vaccination	Seattle, Washington; general practice; adults aged ≥65 years; influenza	1. Mailed client reminder 2. Control	1984 US$; costs included direct costs of mailing reminders, including postage, printing, and envelopes; CE ratio of 1 *versus* 2 = $30/additional vaccination; baseline coverage = 54%; change in coverage = 1%	1997 US$; CE ratio of 1 *versus* 2 = $46.35/additional vaccination
Chiu Ref. 2 1994–96	Cost-analysis; average cost in dollars per child	Jacksonville, Florida; hospital nurseries and communitywide; children aged <18 months; vaccines not specified	1. "Shots by Two" Project; volunteers "adopt" a baby, introduce themselves, and provide four postcard and phone reminders from the child's birth to age 18 months 2. No control	1994 (assumed) US$; estimates do not specify whether per child or per reminder and do not include in-kind contributions of volunteer time; AC = $0.60 /child, county baseline coverage = 64.3%; change in coverage = 16.5% (Entire increase in coverage cannot be attributed to the intervention)	1997 US$; AC = $0.65/child AC is an underestimate because costs do not include in-kind contribution of volunteer time
Frame Ref. 3 1991–92	Cost-effectiveness; cost-effectiveness ratio in dollars per additional vaccination	Dansville, New York; rural; family practice; adults aged ≥21 years; Td booster	1. Computer-generated provider and client reminders and tracking 2. Manual tracking	1992 US$; costs included staff, materials, and postage; cost of installing computer-based system not included; CE ratio = $3.71/additional vaccination; baseline coverage = 20%; change in coverage = 21%	1997 US$; CE ratio of 1 *versus* 2 = $4.41/Additional vaccination This intervention also increased provision of other preventive care; therefore, CE ratio probably underestimates overall CE
Frank Ref. 4 1981–82	Cost-effectiveness; cost-effectiveness ratio in dollars per additional vaccination	Hamilton, Ontario, Canada; urban community health center; adults aged >65 years; influenza	1. Mailed client reminders 2. Follow-up telephone calls to nonrespondents 3. Prior usual care	1982 (assumed) Canadian$; costs included materials, labor, and postage; CE ratio of 1 *versus* 3 = $2.16–$2.50/Additional vaccination; CE ratio of 2 *versus* 1= $5.00–$8.00/Additional vaccination; baseline coverage = 17%; change in coverage attributable to 1 = 26%; additional change in coverage attributable to 2 = 12%	1997 US$; CE ratio of 1 *versus* 3 = $2.80–$3.20/Additional vaccination; CE ratio of 2 *versus* 1 = $6.40–$10.37/Additional vaccination

Table C-1 Continued

Author, Reference Number, Study Period	Analytic Method, Reported or Calculated Summary Measure	Study Location, Setting Type, Population Description, Vaccine	Interventions Studied, Comparisons	Base Year, Costs Included, Reported Summary Measure, Coverage Baseline and Increase	Adjusted Base Year, Summary Measure Adjusted Value, Notes
Grabenstein Ref. 5 1990	Cost-effectiveness; cost-effectiveness ratio in dollars per additional vaccination	Durham County, North Carolina; pharmacy-based; adults aged >64 years; influenza	1. Two mailed reminders regarding risk of influenza and availability of vaccinations 2. No reminders	1990 US$; costs included materials, labor, and professional fees; CE ratio of 1 *versus* 2 = $10.68/Additional vaccination; baseline coverage = 54%; coverage increase = 10%	1997 US$; CE ratio of 1 *versus* 2 = $13.00/Additional vaccination
Lieu Ref. 6 1994–95	Cost-effectiveness; cost-effectiveness ratio in dollars per additional vaccination	Northern California; managed care organization; children aged 20–24 months; MMR	1. Computer-generated personalized client reminders 2. Autodialer telephone system 3. Control group with no reminder	1996 US$; costs included computer costs, printing, clerical labor, postage, and stationary; baseline coverage = 86%; change in coverage = 4% for both 2 and 3 compared with 1; CE ratio of 1 *versus* 3 = $4.04/Additional vaccination; CE ratio of 2 *versus* 3 = $2.14/Additional vaccination	1997 US$; CE ratio of 1 versus 3 = $4.10/Additional vaccination; CE ratio of 2 versus 3 = $2.18/Additional vaccination Assumes same effectiveness for autodialer system in increasing coverage that was observed for recall letters

Table C-1 Continued

Author, Reference Number, Study Period	Analytic Method, Reported or Calculated Summary Measure	Study Location, Setting Type, Population Description, Vaccine	Interventions Studied. Comparisons	Base Year, Costs Included, Reported Summary Measure, Coverage Baseline and Increase	Adjusted Base Year, Summary Measure Adjusted Value, Notes
Lieu Ref. 7 1996–97	Cost-effectiveness; cost-effectiveness ratio in dollars per additional vaccination	Northern California; hospital management organization; children aged 20 months; DTP, OPV, MMR, hepatitis B, Hib	Randomized intervention groups 1–4 as follows: 1. Letter reminder 2. Automated phone reminder 3. Letter followed by automated phone reminder 4. Automated phone reminder and follow-up letter 5. Nonrandomized comparison group	1997 US$; costs included computer time, staff time (e.g., programmers and clerical), maintenance of telephone software, postage, telephone fees, software programming (start-up); CE ratio of 1 *versus* 5 = $10.50/Additional vaccination; using postcard reminders rather than letters would result in CE ratio = $6.50/Additional vaccination if postcards and letters were equally effective; CE ratio of 2 *versus* 5 = $9.80/Additional vaccination; using lower cost assumptions thought to be consistent with costs at a public clinic would result in a CE ratio of $2.20/Additional vaccination; CE ratio of 3 *versus* 5 = $7.00/Additional vaccination; CE ratio of 4 *versus* 5 not reported; baseline up-to-date coverage in the study population not provided; of initially unvaccinated children, 36%–47% were fully vaccinated by age 24 months in the four study groups; change in coverage not calculable from the data presented	1997 US$; CE ratio of 1 *versus* 5 = $10.70/Additional vaccination; using postcards rather than letters, CE = $6.70/Additional vaccination; CE ratio of 2 *versus* 5 = $10.00/Additional vaccination; using lower public clinic cost assumptions would = $2.30/Additional vaccination; CE ratio of 3 *versus* 5 = $7.20/Additional vaccination
McLeod Ref. 8 1996	Cost-analysis; average cost in dollars per child	Wellington, New Zealand; convenience sample of noncapitated and capitated practices; preschool-age children; vaccine not specified	1. Costs of vaccinating preschool-age children among practices participating in a system of audit and feedback and using client recalls and reminders 2. No comparison group	1996 New Zealand$; costs included practice nurse and general practitioner labor, materials, supplies, staff, and receptionist labor; cost of vaccine not included; costs of audit and feedback not included; AC = New Zealand$8.51/child; no baseline coverage data; no change in coverage data	1997 US$; AC = $5.75/child Includes costs of clinical time for providing vaccinations as well as recall; overestimates cost of recall alone

Table C-1 Continued

Author, Reference Number, Study Period	Analytic Method, Reported or Calculated Summary Measure	Study Location, Setting Type, Population Description, Vaccine	Interventions Studied, Comparisons	Base Year, Costs Included, Reported Summary Measure, Coverage Baseline and Increase	Adjusted Base Year, Summary Measure Adjusted Value, Notes
Moran Ref. 9 1991	Cost-effectiveness; cost-effectiveness ratio in dollars per additional vaccination	Boston, Massachusetts; urban community health center; poor to lower income; aged ≥65 years or <65 years but at high-risk; influenza	1. Educational brochure 2. Lottery-type incentive 3. Both educational brochure and incentive 4. Control group of usual care	1991 (assumed) US$; costs included graphic development, printing, prizes, postage, and clerical labor; costs of vaccine, software, tracking hardware, and student personnel not included; CE ratio of 1 *versus* 4 = $3.45/Additional vaccination; CE ratio of 2 *versus* 4 = $8.74/Additional vaccination; CE ratio of 3 *versus* 4 = $43.06/Additional vaccination; baseline coverage = 20%; coverage increase 1 = 16%, 2 = 9%, and 3 = 6%	1997 US$; CE ratio of 1 *versus* 4 = $4.06/Additional vaccination; CE ratio of 2 *versus* 4 = $10.00/Additional vaccination; CE ratio of 3 *versus* 4 = $50.73/Additional vaccination
Nexøe Ref. 10 1995	Cost-effectiveness; cost-effectiveness ratio in dollars per additional vaccination	Denmark; general practices; adults aged ≥65 years; influenza	1. Mailed invitation for vaccination 2. Mailed invitation *plus* free vaccination 3. Comparison group of usual care	1995 US$; costs included postage and vaccination administration; CE ratio of 1 *versus* 3 = $21.00/Additional vaccination; CE ratio of 2 *versus* 3 = $40.50/Additional vaccination; includes price of vaccine; baseline coverage = 25%; coverage increase 1 *versus* 3 = 24%; 2 *versus* 3 = 47%	1997 US$; CE ratio of 1 *versus* 3 = $22.10/Additional vaccination; CE ratio of 2 *versus* 3 = $43.00/Additional vaccination
Rosser Ref. 11 1983–86	Cost-effectiveness; cost-effectiveness in dollars per additional vaccination	Ottawa, Canada; University of Ottawa Family Medicine Center at Civic Hospital; adults aged >20 years; tetanus booster	1. Physician reminder 2. Telephone reminder by nurse 3. Letter reminder 4. Randomized control	1985 Canadian$ (assumed); direct costs, including medical and nonmedical staff labor, postage, and stationary; cost of producing provider reminders not included; CE ratio of 1 *versus* 4 = $0.43/Additional vaccination; CE ratio of 2 *versus* 4 = $5.00/Additional vaccination; CE ratio of 3 *versus* 4 = $6.50/Additional vaccination; baseline coverage = 3%; change in coverage, 1 = 20%, 2 = 21%, and 3 = 27%	1997 US$; CE ratio of 1 *versus* 4 = $0.70/Additional vaccination; CE ratio of 2 *versus* 4 = $8.75/Additional vaccination; CE ratio of 3 *versus* 4 = $9.75/Additional vaccination

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